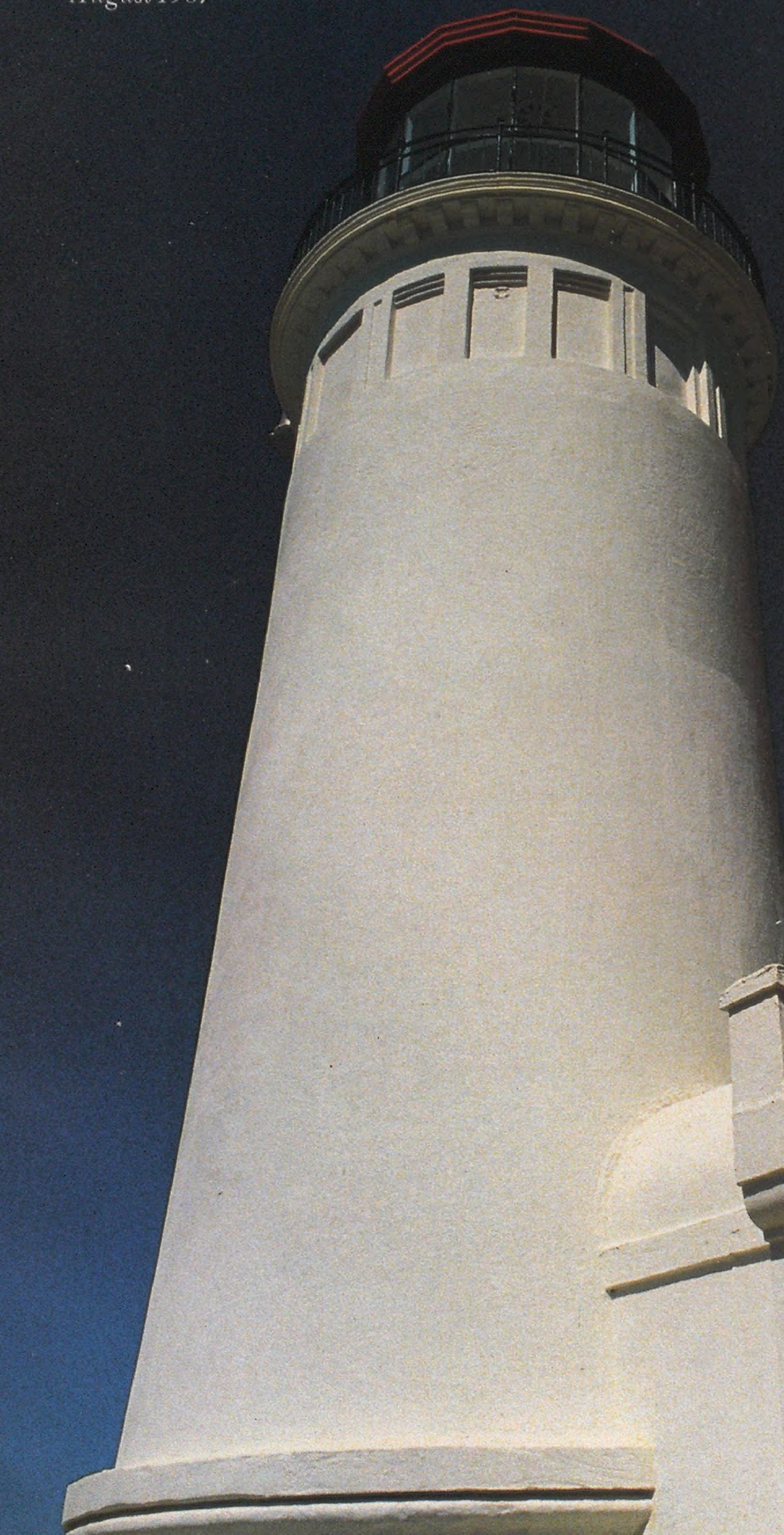
Smithsonian

August 1987



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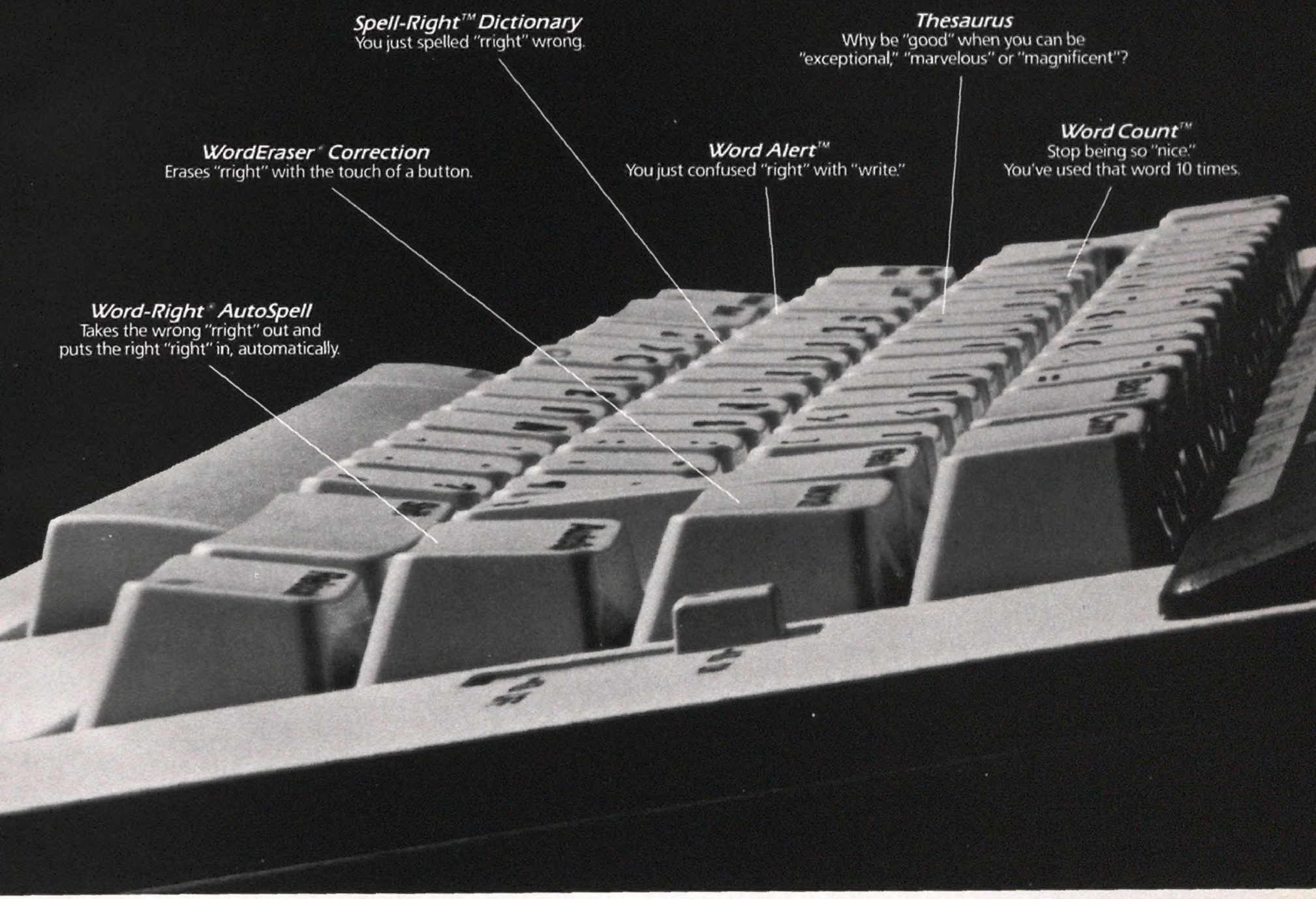
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August 1987

Smithsonian

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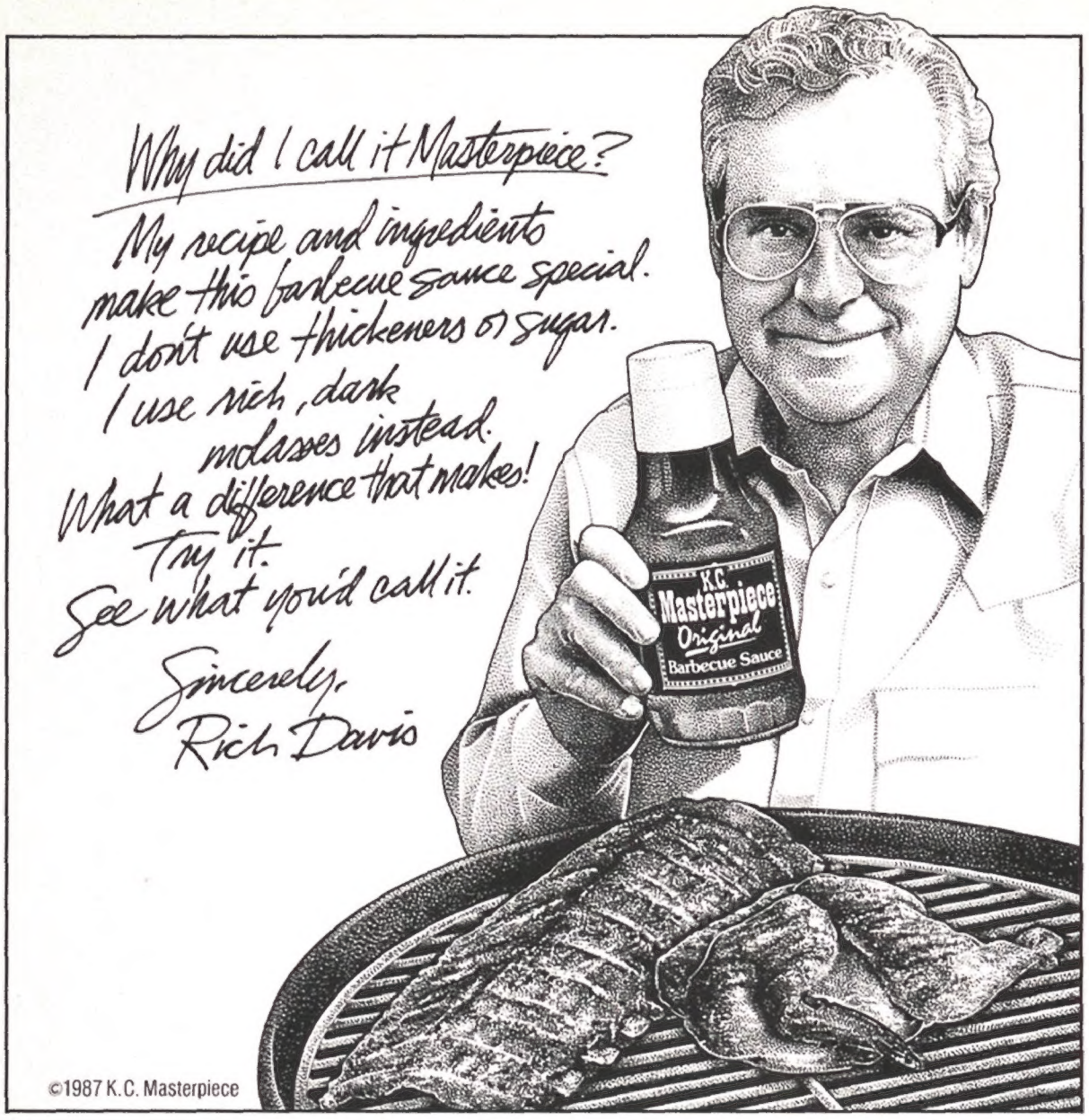

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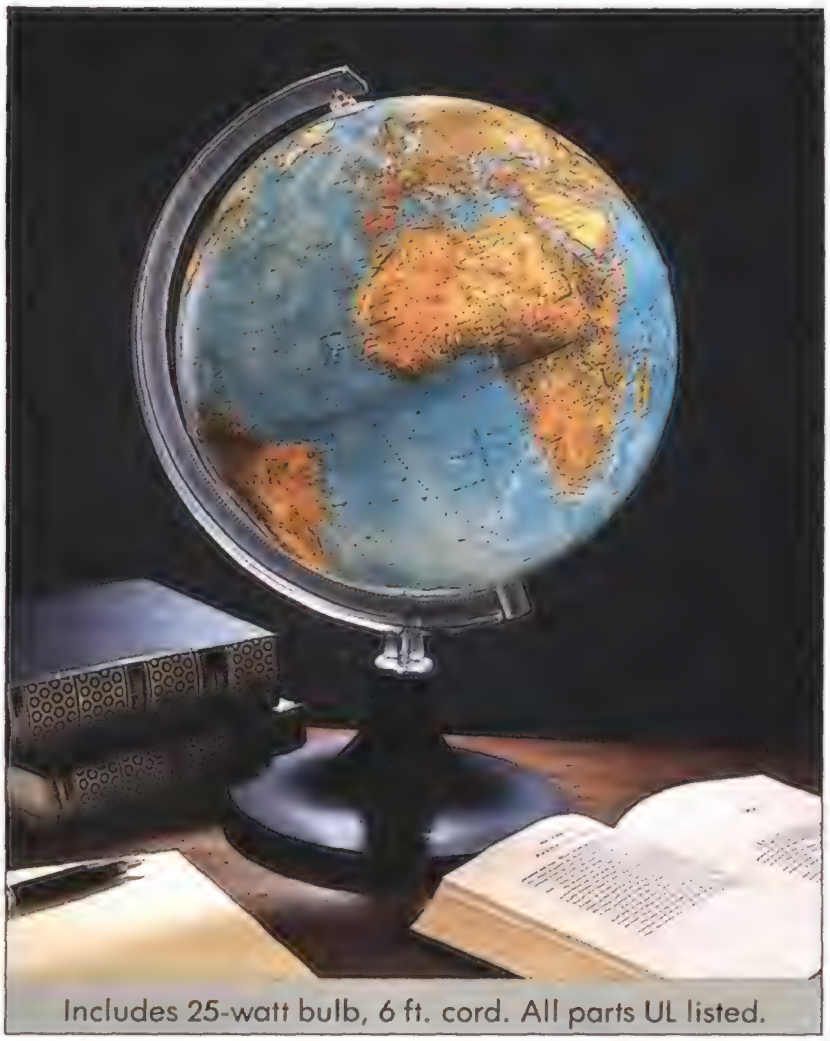

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Secretary Adams' comments

Smithsonian horizons

Evidence that the world's climate may be changing irreversibly has not yet resulted in any coordinated response

Everybody talks about the weather, but nobody does anything about it. With national radar coverage instantly at the call of scores of TV weathermen, the first part of that old saying is perhaps truer than ever. But the second part is something else again. Largely as a by-product of human activities, the whole world has been launched on an enormously complex process of climatic change that may well be irreversible. But though their economic and social impacts will be huge, timing and calculation of regionally differentiated effects are still an inexact science. Given this uncertainty, there is not yet anything approaching the level of general concern needed to explore seriously the limits and possibilities of some sort of coordinated international response.

The essentials of the so-called greenhouse effect have been understood for a very long time. Carbon dioxide is most prominent among many atmospheric trace gases that permit the inward passage of the energy in sunlight while absorbing the less energetic infrared radiation that otherwise would dissipate some of the heat from the sun back into space. Preindustrial levels of carbon dioxide are being exceeded at an accelerating rate—by 25 percent or so during the past hundred years, and currently by an additional 0.5 percent per year. (These rates are now monitored at many stations worldwide, including the Smithsonian's research facilities on Chesapeake Bay and in Panama.)

Carbon dioxide is the principal product of fossil fuel combustion. Fossil fuels, which contribute so importantly to industrial development and human well-being, ironically may now be endangering that well-being. About half of the gas thus generated is absorbed by the world's oceans and plants and trees, but the remainder traps an increasing proportion of the sun's heat near the Earth's surface. While there are substantial differences in current estimates, a range between 3 and 10 degrees F of warming within the next century is certainly credible. By the time even the middle of this range is reached, the Earth will be warmer than it has been for the past 100,000 years.

Other trace gases greatly complicate the picture and add urgency. Methane, tropospheric ozone, nitrous oxide and the chlorofluorocarbons, all associated with rising demands for food and energy, play important additive roles in climatic warming. The latter two are thought to be major contributors to a suspected, and perhaps rapid, depletion of the protective barrier of stratospheric ozone. More ultraviolet radiation could reach the Earth if this occurs, increasing the incidence of skin cancer and having serious implications for both terrestrial and aquatic plant life.

We must not minimize these uncertainties and difficulties. Forecasts of future emissions levels, tied not only to international levels of industrial activity and development but to possible improvements in the efficiency of energy generation and consumption, are perilous at best. Models on which to base estimates of the net radiation balance still treat clouds, for example, only as gross aggregates over large areas, although it is known that daytime and nighttime clouds of different types can have diametrically opposed effects. Perhaps most difficult to calculate are the effects of positive and negative feedback. Increasing carbon dioxide, for example, will stimulate plant growth and thus mitigate its own effect. A warmer atmosphere will hold more water vapor, which will also hasten the decomposition of methane.

Warming will lead to some melting of the polar ice caps and a consequent rise in sea level. Coastal losses or protective barriers might be amortized tolerably in developed countries, but what would be the effect in Egypt if a likely fifth of the inhabitable area were inundated? Many scenarios show a pronounced trend toward drought on our High Plains and in the Southwest, and the grain belt will migrate northward. This would be a damaging blow to the United States. Canada and the Soviet Union, as the potential beneficiaries, are hardly likely to be enthusiastic supporters of international measures to slow or ameliorate climatic warming.

Measures are getting under way to reduce the major uncertainties. It is widely recognized that the physical and biological parameters of change constitute a single, densely interacting system. Plausible policy options are slower to appear. Surely there will be a growing need for energy conservation, and a permanently enlarged role for nuclear power seems almost as inescapable, though steps must be taken to reduce its risks. But most such decisions must follow rather than anticipate a great deal of further clarification.

Beyond this, we must recognize that residuals of physical and biological uncertainty will remain, and that option papers by themselves rarely lead to action. The problems of building a basis for international cooperation directed toward common, long-term ends are social problems. Difficult and diffuse as they are, they will be informed by social scientific studies and solved by political processes—or they will never be solved at all.

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Letters to the Editor

New telescopes

Dear Sir: The picture on your June cover appears to me to be a composite, not an actual photographic time exposure from Hawaii. Why didn't you say so? However, your statement that it represents a two-hour exposure seems right on, because the arcs measure exactly 30 degrees.
Jonathan W. King jr.
Owensboro, Kentucky
Roger Ressmeyer, who made the photograph, says that Mr. King is correct on the second count, wrong on the first. The center of the circle is the North Celestial Pole, and the length of the star trails proves that the shutter was open for two hours. The exposure began at the very end of dusk, and so a little bit of dusk remains on the horizon. It ended at moonrise, when the moon is red, and therefore threw a bit of pink on the dome. During the two-hour exposure one astronomer drove his car, warning lights flashing, around the dome. Another took a stroll on the catwalk with a flashlight, checking out the sky. And the dome rotated, which is why you see that little bit of ghosting along its upper-left edge, a natural effect on a time exposure when there is motion in the picture. Ed.

Dear Sir: As an amateur enthusiast of all things astronomical, the anticipation of discoveries to be revealed by the marvelous new telescopes makes the waiting almost unbearable.

But I have a small technical bone to pick with your use of the term *centrifugal* force, a misconception perpetrated by the popular press, even by such astute publications as SMITHSONIAN. In the spincasting of mirrors as described in the article, inertia of the rotating, molten glass and the *centripetal*, or inward-directed, force of the sides of the oven on the glass are the agents that mold it into its parabolic shape. No *centrifugal*, or outward, force acts on it.

We in engineering education have lots of trouble trying to disabuse freshmen students of their misconception about *centrifugal* force. Please try to help us.
Thomas P. Zurflieh
Associate Professor
Department of Engineering Technology
St. Petersburg Junior College
Florida
Gladly, Prof. Zurflieh—had not you so clearly said it all. Ed.

Codebreaking

Dear Sir: Referring to your June article, Shakespeare addicts are grateful for what David Kahn called Friedman's "witty exposé of the 'kooks' who decipher false authorship claims of Francis Bacon." The late Professor G. L. Kittredge is supposed to have remarked that using the techniques of said "kooks," he could demonstrate that his dinner menu had been composed by Keats or Shelley.
William W. Wright
Corning, New York

Dear Sir: Let this great-grandmother set you straight:

No one who works Cryptoquip, Cryptoquote or Celebrity Cipher, all found in the newspapers, would dream of solving your code with the rigamarole you suggested. My first clue was the *D*, which could be an *I* or an *A*, but when I spotted the combination of ZSDZ for THAT, the rest was duck soup—or at least alphabet soup.
Lou Camp
Albuquerque, New Mexico

ANEW GHW: ZPVW OHFSNW JEG E FHNON PI OELN. TVB PI OPVWGN, H'KN TNNM APHMR OPANG EMA OHFSNWG PII EMA PM GHMON H JEG E LHA, JSHOS CEZ RP BP GSPJ BSEB E FWEOBHONA APR, EB UNEGB, APNG MPB IPWRNB EUU PI HBG BWHOLG. GBHUU, BSN GFNUUHMR OSNOL PM CZ BZFNJWHBNW HG ETPVB BP GSPWB-OHWOVHB EG H JWHBN BSHG. BSEMLG IPW BSN IVM, EMA WNCNCTNW, "IWNYVNM-OZ OPVMBG."
WHKE LVSU
TPJUHMR RWNNM, PSHP

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Dear Sir: Even though Mr. Chiles relegates the area in which Fabyan Park is located to a Chicago suburb, the majority of Fox Valley towns and cities do not consider themselves as such. Algonquin, East and West Dundee, Elgin, South Elgin, St. Charles, Geneva, Batavia, North Aurora and Aurora were all settled along the Fox River and many were incorporated in the 1840s, as was Chicago. All have a colorful history of their own.
Raleigh Sutton
Elgin, Illinois

Mont Blanc

Dear Sir: My great-grandfather John Randall did indeed die on Mont Blanc, but your report errs in saying his body was never found. It emerged some years later at the bottom of the glacier into which he was blown by the gale winds prevailing that day. The Mayor of Chamonix offered to honor him by having him buried in the mountaineers' cemetery.

I'm not sure being this sort of footnote to history would have satisfied his purpose in going there, but it might have made him laugh.
Frank Pierson
Pacific Palisades, California

Indy's new image

Dear Sir: Although on the whole Mr. Jackson's article was accurate and interesting, I resent his fatuous statement that "Hardly anyone mentions the Indy 500 nowadays. . . ."

Nothing could be further from the truth. As Richard K. Shull points out in rebuttal in the *Indianapolis News*: "Sportswriters are probably 'hardly anyone.' But you can't discount the 250,000-plus seatholders in the stands on race day or the hordes that swarm the infield like army ants. They all paid money to be there, and that qualifies them to be 'anyone' with a couple of 'hardlys' thrown in as a bonus."
Bill Brooks
Carmel, Indiana

The APHIS team

Dear Sir: As two of those federal inspectors who keep forbidden fruit and other prohibited agricultural items out of the country, we realize how important it is for people entering the United States to know why some of their foods may be taken from them. Unfortunately, we rarely have time to fully explain.

Your emphasis was on airports, but our interesting and at times adventurous job has other aspects. In addition to inspectors clearing importations abroad before shipment to the United States, thousands of cars are stopped daily at both our Northern and Southern borders to check for prohibited foods.

Most of our commercially imported foods come in as ships' cargo. Hundreds of millions of tons cross both the Atlantic and Pacific oceans from nearly every nation in the world. We work at the largest containerized cargo port in the country, where much cargo is inspected, approved or disapproved, some destroyed, some fumigated by APHIS.

Foreign ships are boarded on arrival; food stores used by the crew are examined for pests and, if necessary, held under quarantine so that no important pests can escape.
Patricia C. McCroy
Robert L. Schaffner
Port Elizabeth/Port Newark, New Jersey

Jacob Lawrence

Dear Sir: You identify Frederick Douglass' *North Star* as the first black newspaper, but 20 years before its appearance in 1847, two black men, John Russwurm and Samuel Cornish, published *Freedom's Journal.* Its first issue, in March 1827, carried these memorable lines: "We wish to plead our own causes. Too long have others spoken for us."

Russwurm, the first black graduate of an American college—Bowdoin, 1826—and Cornish, a Presbyterian minister, added: "From the press and pulpit we have suffered much by being incorrectly represented. . . . Our vices and our degradation are ever arrayed against us, but our virtues are passed by unnoticed."

Douglass became a greater black journalist, but he wrote no lines surpassing these as summary reasons for a black press.
Warren Francke, PhD
Professor of Communication
University of Nebraska at Omaha

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Miniature golf

Dear Sir: Three years ago, at the Park Hotel in Baden bei Wien, Austria, I would take a predinner cocktail on my balcony, watching the action on the hotel's miniature golf course across the way.

One Sunday there appeared a sextet of men and women who were unbelievably good. On one hole, a 50-foot arcing shot, five of them made holes-in-one. I asked the owner about them. They were members of a team that played in an All-Austria League, and their cases were covered with round stickers—the kind that people used to plaster all over their steamer trunks in the 1920s—representing the towns and cities in which they had competed.

J. Stuart Morrow
Sewickley, Pennsylvania

'Who can serve better?'

Dear Sir: From one Cancerian to another, thanks for the publicity. Incidentally, have you tried Ping-Pong? I think that's where you may shine. Volley them to death! Serves are easier, too.

Carolee Pekrul
Long Beach, California

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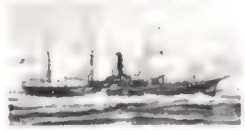

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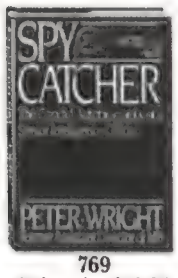

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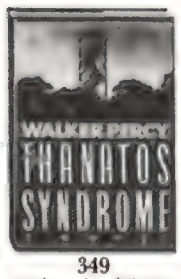

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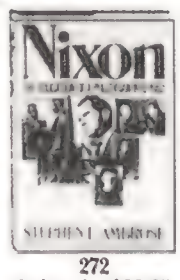

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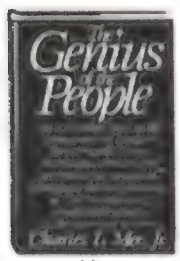

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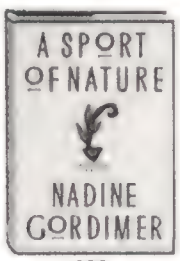

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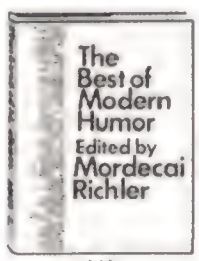

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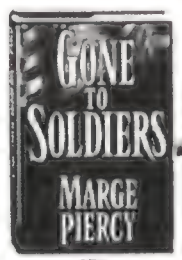

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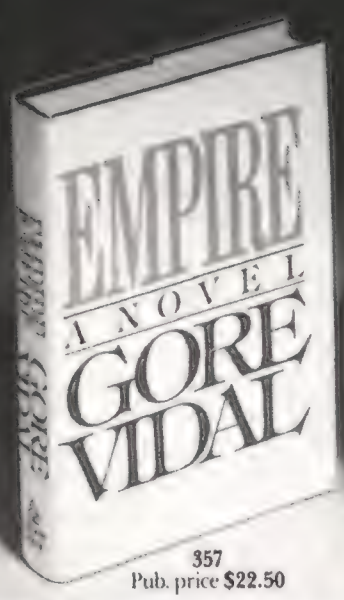

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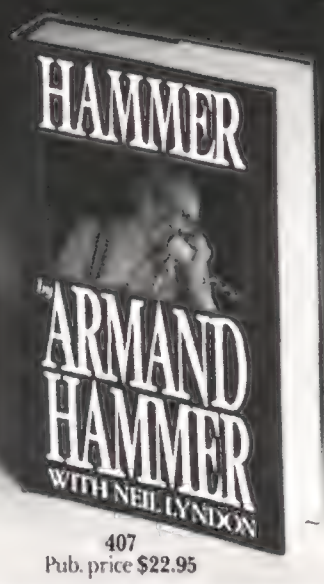

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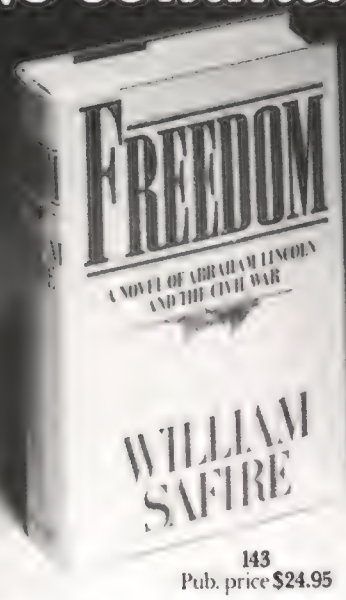

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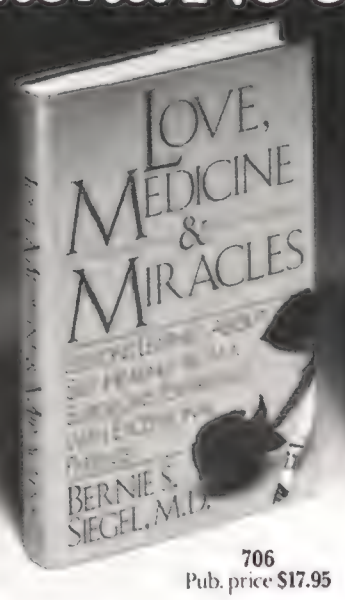

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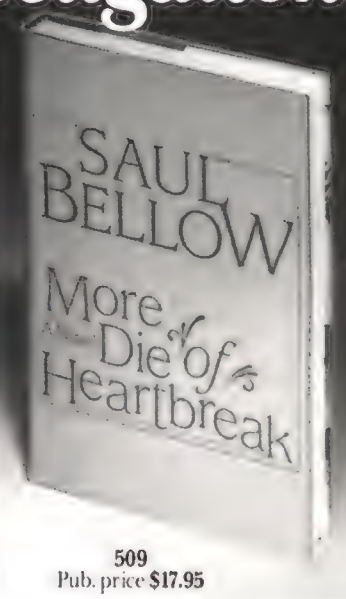

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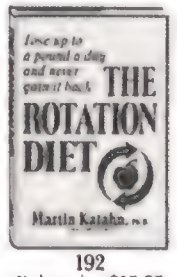

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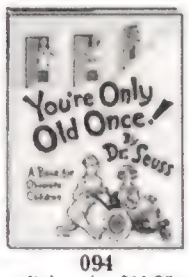

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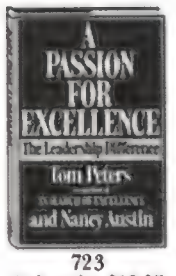

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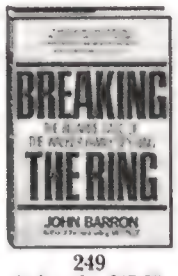

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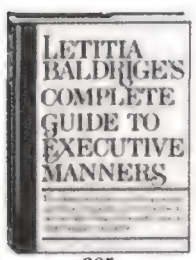

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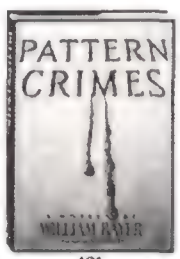

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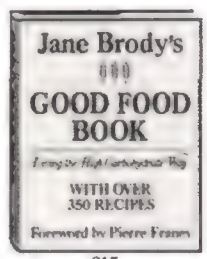

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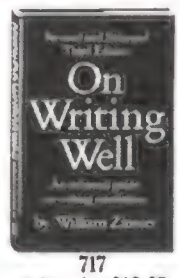

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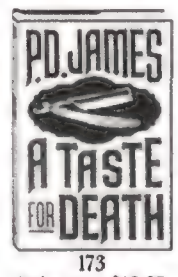

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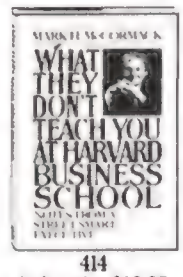

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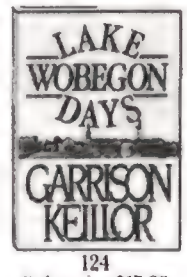

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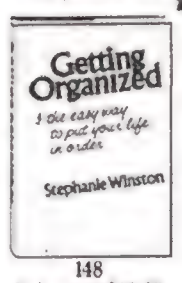

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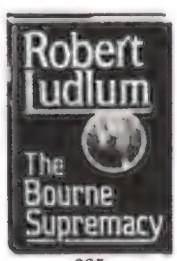

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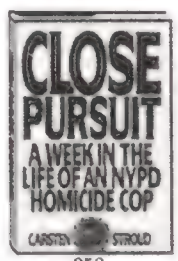

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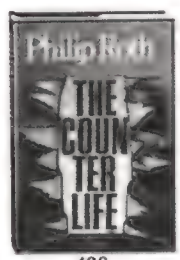

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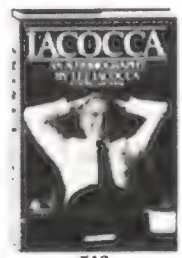

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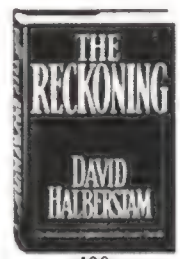

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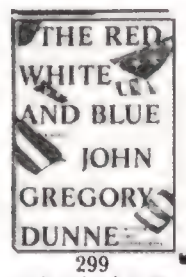

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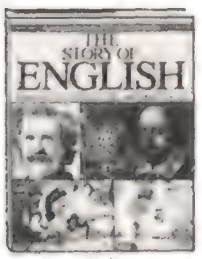

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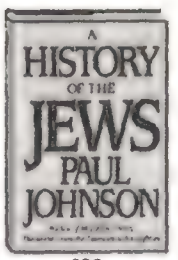

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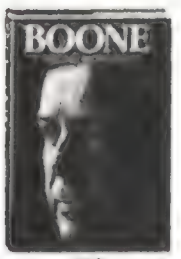

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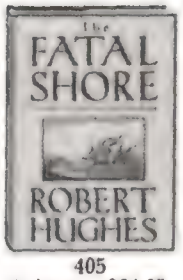

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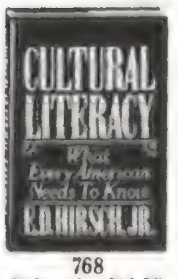

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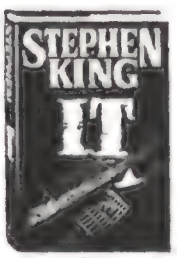

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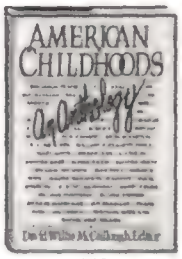

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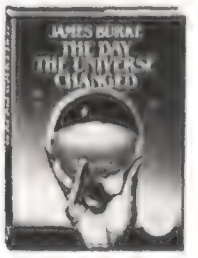

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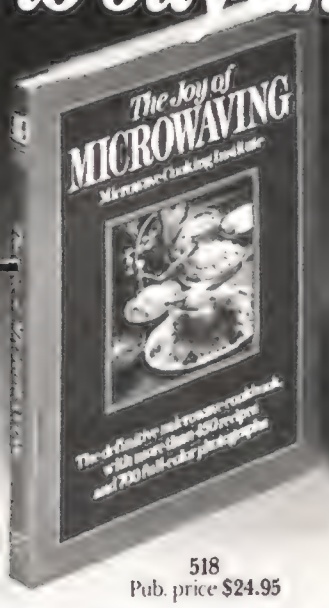

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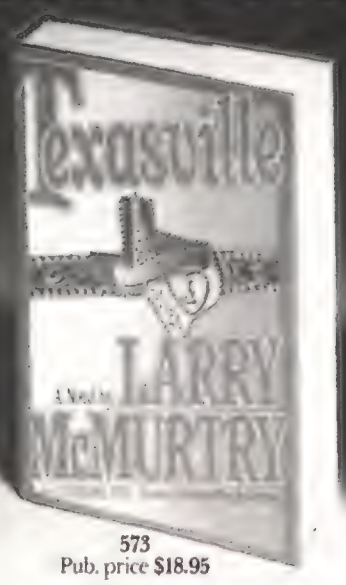

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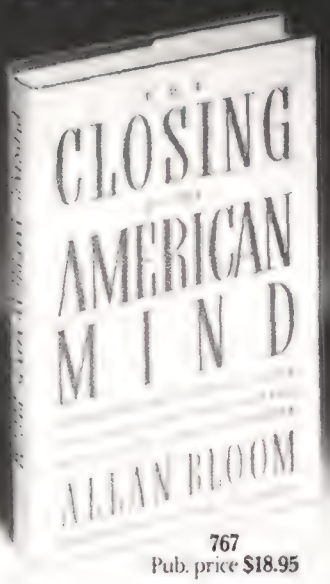

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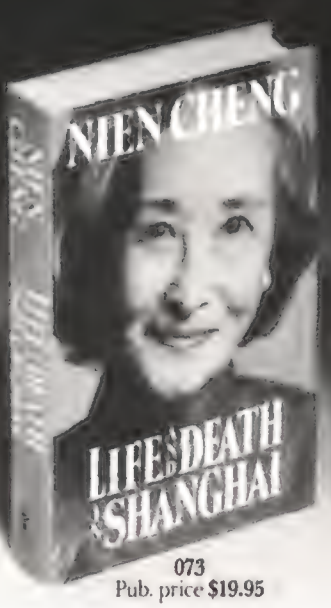

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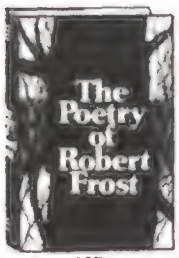

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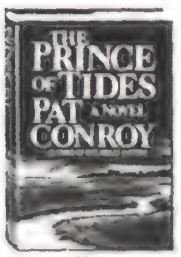

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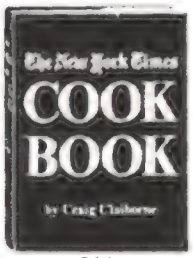

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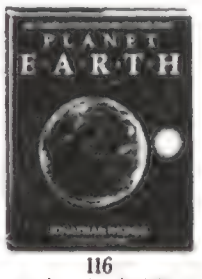

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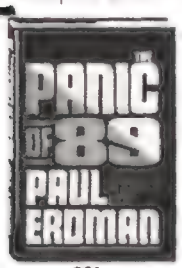

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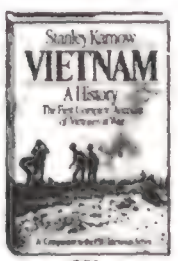

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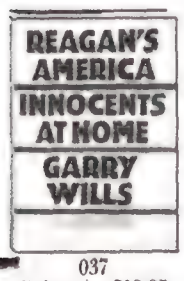

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I got caught in the jam on a humid morning last May, for I was determined to reach the University of Virginia in time to watch a certain unique event. Our Smithsonian was joining the university and the American Bar Association in a deep bow toward the Bicentennial of the U.S. Constitution. Thanks to Wilton S. Dillon of the Office of Interdisciplinary Studies, and to support from a number of foundations and businesses, we were putting on a six-day symposium entitled "Constitutional Roots, Rights, and Responsibilities" in Charlottesville and back in Washington (below). As

Britain's Lord High Chancellor at D.C. symposium. Secretary Adams is at far right.

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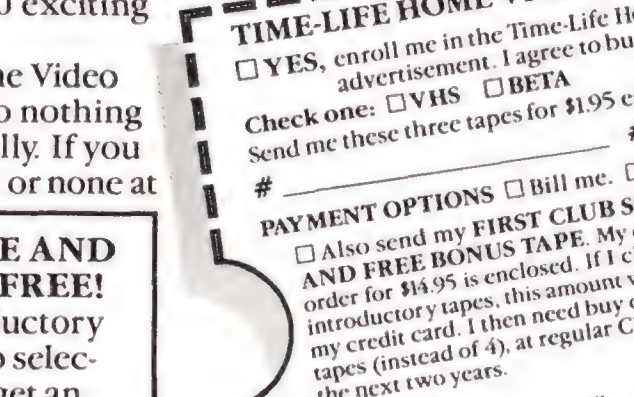

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a compulsive anniversary noter, I intended to drop in on it.

At 8:30 this particular morning, an academic procession was scheduled to traverse the length of the old university "Lawn" from Cabell Hall to Mr. Jefferson's famous Rotunda. Brains on parade. I felt I shouldn't miss it. So I glanced at my watch with growing dismay as I sat behind an 18-wheeler at a stoplight, breathing diesel reek and listening to rock music from the open window of the pickup beside me.

Green at last. The trucks groaned forward and I raced down a cross street to the university. I seized an illegal parking place and hurried toward the unmistakable, neoclassic dome of the Rotunda that Jefferson had designed as the university's heart. Mounting the steps, I joined a scattering of people from the public relations office, the faculty, the legal profession, the fourth estate and the Smithsonian—a group momentarily augmented as morning runners panted up, marked time for a moment, then padded off again.

The procession was late. We fretted, wondering whether our cars were being ticketed and what we were missing on the news. Gradually we stopped whining.

Before us lay a couple of hundred yards of serene Virginia lawn, broken by two terraces that reminded me of "ha-has"—sudden depressions (walled ditches or sunken fences) in the ground that tickled our forefathers because you didn't see them until (Ha-ha!) you almost tumbled into them. The small classical columns of Jefferson's tree-shaded colonnades flanked the lawn. Morning mist wreathed eerily above the damp grass. The only scent that reached us was floral, the loudest sound the imperious whistle of a courting cardinal, brilliant in red. The procession was late. Who cared?

Then in the distance, around the columns of Cabell Hall, dark-gowned figures gathered, forming a double file. The group began to move with deliberate pace through the heavy dew, disappearing under the edges of the terraces, reappearing closer at hand and finally mounting the broad stairs of the Rotunda. Sober academic robes blazed with traditional colors of ancient degrees.

I looked in vain for Thomas Jefferson. Instead (and surely Jefferson would have approved), the then Lord High Chancellor of Great Britain, in wool wig and gold-flecked robe, leaning on two canes, bravely attacked the stairs. Lord Hailsham of St. Marylebone, in his 80th year, may have been the oldest and wittiest, but was by no means the only, foreign participant. Others of the more than 90 dignitaries who took part in the symposium represented Austria, Argentina, France, Israel, Italy, Japan, Nigeria, the Philippines, Switzerland and West Germany. All had come to discuss the strange and radical notion of a constitution for the United States.

They had met the evening before at Mr. Jefferson's home, Monticello, for a reception, and later listened to former Chief Justice Warren E. Burger in the same great room they now entered, under the Rotunda dome. So they knew one another. As they passed me I heard murmurs of what must have been scholarly conversation. I was even privy to (save the mark!) a discreet chuckle.

The notables took seats in this gently classical, totally American room, its oyster-white walls almost bare of embel-

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lishment, adding a sense of freshness, of innocence, of newly won independence. Here I listened to opening speeches, and to a robin's song outside. I thought of the other, older American room in Philadelphia where, 200 years ago, fat flies had buzzed about in the summer heat, and voices of other, not dissimilar, jurists and scholars had droned, day after day, debating various points that became—or did not become—part of the Constitution here being extolled.

I didn't stay very long. The participants were off for Washington in the afternoon, there to continue discussions for the rest of the week. I realized, wrenching myself back to 1987, that I, too, had to get back, allowing time, of course, for the truck traffic.

This Smithsonian symposium drew scholars from 21 American and 11 foreign universities. U.S. notables included our own Secretary Robert McC. Adams, Associate Justice of the Supreme Court William J. Brennan jr., historian Henry Steele Commager, Senator Nancy Landon Kassebaum, Secretary of the Army John O. Marsh jr., former Senator Charles McC. Mathias jr., Attorney General Edwin Meese III, consumer advocate Ralph Nader and Speaker of the House Jim Wright. Among the foreign dignitaries were the Lord High Chancellor and Robert Badinter, president of the French Constitutional Council.

Obviously, some discussions tended toward subtle considerations, and some titles were pretty formidable: "Roots and Limits of Judicial Review"; "The Local and Consensual Foundations of Constitutional Authority in the Early Modern British Empire"; "The United States Constitution, Public Opinion and the Question of American Exceptionalism." Yet those who heeded found rich veins indeed; and those of us who experienced that first venue, Charlottesville . . . well, all I can say is, "Beam me down, Scotty."

A more direct confrontation with this Bicentennial comes, oddly enough, from one of the biggest and most powerful of those very trucks that almost foiled my escape into the past. A mighty Kenworth 18-wheeler, thundering with 444 horses behind gleaming stacks, has been cruising around the United States at 65 miles per hour behind various state troopers. The cargo in the 40-foot red-white-and-blue trailer includes one of the drafts of the Constitution; copies of such other documental milestones on the road to democracy as the Fundamental Orders of Connecticut and the Declaration of Independence; and facsimiles of others, such as the Mayflower Compact. The greatest and rarest treasure in the truck is one of four originals still in existence of England's 772-year-old Magna Carta.

Sponsored by American Express, the Commission on the Bicentennial of the U.S. Constitution, and the U.S. Constitution Council of the Thirteen Original States, this "Roads to Liberty" tour (its exhibit designed by the Smithsonian) was kicked off in Washington last March, and returned here the first week in June. The truck anchored right next to the National Air and Space Museum for four days, then headed off to Delaware—the first state to ratify the Constitution. I met it in Delaware's historic Georgetown.

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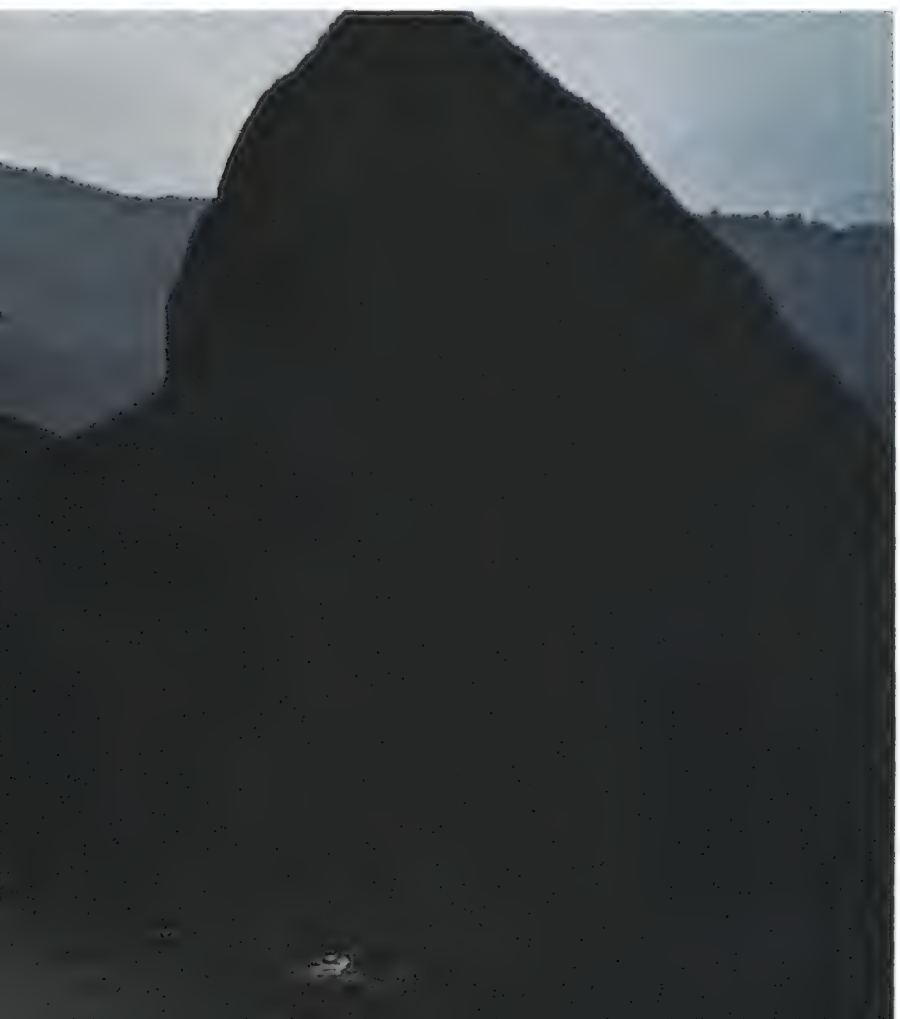

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13 original states." He added, and everyone agreed, that the truck always draws an enthusiastic throng. "When we arrived here yesterday, they put on an exhibition of jousting for us. Amazing."

The route has changed and expanded since its start. "We set out for the Northwest Ordinance states right off, and then we took the stuff as far as Nebraska and Texas." The Northwest Ordinance, which is also on display in the truck, was the 1787 plan of government for the territory that later provided the states of Illinois, Indiana, Ohio, Michigan, Wisconsin and part of Minnesota. Nord knew this cold. I had to look it up. Security is tight, of course. If all else fails, he says, "we have three swords, two flintlock pistols and a musket on display."

The copy of Magna Carta ("Maggie" to those on the tour) comes from England's Lincoln Cathedral, where it first arrived on June 29, 1215. Canon John Nurser of the cathedral, resplendent in white summer canonicals, happened to be on this part of the tour, keeping an eye on things, and he told me that the old parchment resides in an archival room off the library. Maggie's first visit here was in 1939, when she came to the British Pavilion at the New York World's Fair. Caught by World War II, she accepted President Roosevelt's invitation to stay for the duration at Fort Knox.

Neatly written on calfskin in Medieval Latin by a scribe after the showdown with King John that inspired it, Maggie wears her years very gracefully. John was broke as usual, and had to knuckle under to a parcel of rebellious barons and churchmen, and accept their demands for more rights. And that, my fellow students, was a step toward "We the people. . . ."

Until the middle of next month, Maggie and the Constitution (Connie?) and their friends are wheeling around America in their handsome semi: Annapolis, Asheville, Atlanta and on through the alphabet, winding up in Philadelphia, September 15-18. And the people crowd aboard on a portable ramp to gaze at old words, stare at the replica of King John's mighty sword, smile shyly at the huge trooper standing guard and read a little of their own Constitution.

It was hot in Delaware; the truck air conditioner was going full blast. A radio was on in the cab, too, but softly: the Johnson Mountain Boys in a bluegrass tune. I leaned confidently against the bright, clean door for a moment to listen.
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Phenomena, comment and notes

For those biologists who want to save life as well as study it, a sense of hope is the most important equipment

Sometimes the more you know, the worse things look. As you acquire even a dim vision into the past, you simultaneously begin to sense the future. A snapshot becomes a moving picture. There is a pleasure in learning to see what is happening, and a sadness at what is actually seen.

Last summer I was ecstatic walking the paths of Rocky Mountain National Park, feeling as close to wilderness as I ever had. I was a little disappointed to learn that 40 years earlier men had driven a 48-inch water tunnel under all those mountains. Back home I was further chastened when a Park Service friend argued that what I had not been able to see in my one and only visit was the deterioration of the park over the years: the loss of native vegetation, the invasion of the exotic, and the shifting and dwindling animal populations.

Then last winter the British Journal *Nature* published a summary of a doctoral dissertation by William D. Newmark, who showed that even the largest U.S. national parks in the conterminous states are slowly but surely losing animal species. I dream my dreams of Africa, where large animals still roam much as they did in the Pleistocene, and then think that human population pressures will make land too valuable to leave for animals so that wealthy tourists from other continents can come to see them.

It becomes all too easy to view the whole conservation movement as a rearguard action, delaying but not denying total defeat. The unarticulated dream of

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conservationists is that someday, in a future many human lifetimes away, we will learn to live in equilibrium with our planet, to manage it so that topsoil does not flow to the sea and poisoned air does not kill vegetation. Just as zoos breed endangered animals in the hope that someday they can be returned to their natural habitats, so conservationists proceed in the unspoken belief that someday the tide of battle will turn. No more wetlands will be drained, no more river water diverted for agriculture in the desert. Instead, men will intervene and manage, but now to help restore what once was naturally there. Marginal lands will be allowed to revert to the wild, and parks and refuges managed according to thousand-year plans.

This belief that a better future is possible is the virtue called hope. The corollary is that action now can make it happen. And so the conservationists press on, with as many approaches as there are species of wildflowers in an acre of undisturbed prairie. An ecological philosopher like Arne Naess struggles for years with the ethics of walking fields and woods, wondering if he has the right to trample tiny seedlings. An activist may decide it is more important to walk the halls of his state legislature and the Congress, lobbying for living things, rather than to wander the meadows and streams he loves so well. A lover of the natural world may take the global view, devoting his life to turning back the minute hand on the cover of the *Bulletin of the Atomic Scientists*, that symbolic estimate of how close the world is to nuclear war.

Many enlist directly in the conservation movement. They join traditional organizations or form their own ad hoc groups, raising money and politicking for refuges and preserves, trying to save a little of the world from the bulldozers of civilization. The organizations are expanding their scope, especially in making partners rather than clients of their counterparts in other countries.

Professional biologists have always been a key element and now they, too, are nailing their colors to the mast. A little more than two years ago, a group of biologists attending a conference at the University of Michigan decided to form yet another scientific organization. At about 5 P.M. on May 8, 1985, the Society for Conservation Biology was born in Ann Arbor. Last May, Volume 1, Number 1 of *Conservation Biology*, the society journal, appeared. It is 92 pages of formal papers, statements of purpose, philosophical exchanges, book reviews and commentary. Symbolically, the cover is a painting of a cerulean paradise-flycatcher, an Indonesian bird last seen in 1978 and now believed extinct. (About the time the journal appeared, newspapers were reporting the death of the last dusky seaside sparrow in Florida. They were dark, nondescript birds with none of the brilliant color of the Indonesian flycatcher, yet I felt the impending loss when I visited the only remaining five in 1982, knowing they were the last of their kind.)

The editor is David Ehrenfeld, the Rutgers biologist who is the author of *The Arrogance of Humanism*. President of the society is Michael E. Soulé of the University of Michigan, who has edited the proceedings of the last two conferences on the subject, the latest appearing in 1986 as *Conservation Biology: The Science of Scarcity and Diversity*. The

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Smithsonian is well represented, with Devra G. Kleiman, assistant director for research at the National Zoo, on the board of editors and Katherine Ralls, a research zoologist there, a governor of the society.

Papers in the premier issue touch on many of the central concerns of conservation biology. They include:

• A report on recent and potential extinctions on Sulawesi and neighboring islands in Indonesia. Little research is being done there, and little of that is being collated. None of the species facing extinction has ever appeared in the Red Data books of the International Union for the Conservation of Nature and Natural Resources (IUCN).

• A discussion of the philosophy of public policies on wolves in Norway by Arne Naess and biologist Ivar Mysterud. At present there are 4.1 million people, 3.2 million sheep, and 5 to 10 wolves. Sheep farmers want the wolves dead; others think the country would be poorer without them.

• Questions about the value of corridors connecting wildlife refuges. Daniel Simberloff of Florida State University and James Cox of the Florida Game and Fresh Water Fish Commission point out that corridors could transmit contagious diseases, fires and other catastrophes, and increase exposure of threatened animals to predators, domestic animals and poachers.

• A suggestion that we may be seriously underestimating the numbers of recently extinct and endangered species, especially in the tropics. Jared M. Diamond of UCLA writes that while we now assume a species is extant until proved extinct, we must turn that sentence around for tropical countries. In the Solomon Islands, where he worked from 1969 to 1976, an even dozen species of birds have not been seen since 1953. Of the 12, only one is mentioned in the Red Data Book *Endangered Birds of the World.*

In an inaugural editorial, Ehrenfeld invites everyone concerned into the new journal. He wants the taxonomists, the population biologists, the resource managers. He wants people in paleontology, climatology, oceanography, anthropology, philosophy and ethics, and economics. He wants to include nongovernmental conservation organizations, federal and regional agencies, conservation lawyers and fund raisers. "The success of *Conservation Biology*," he writes, "depends upon the degree to which we can obliterate the distinction between readers and contributors."

Noting that the field is one of controversy and quarrels, Ehrenfeld is establishing the machinery—departments for letters, editorials, comments and one called Diversity—to provide a forum for every voice. In the kickoff exchange under that last heading, Archie Carr III, assistant director of Wildlife Conservation International, worries that geneticists will dominate the new society, while David F. Hales of the University of Michigan advises Carr that biologists' "contributions are only essential, not sufficient."

It promises to be a lively journal, with plenty of conflict. The very vehemence of the coming war of words proves that all these practitioners of conservation biology share an important trait: they care, because they have hope. They think it is worth their life's work to find out what's happening, figure out what needs to be done, and then do it.

Meanwhile, the rest of us do what we can. It means extra effort. But this is no time to get discouraged.

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Opposite: Listening for leaks, a city worker uses an electronic device to take the pulse of a water main buried under Wall Street. Nearly 70 years ago (above), inspector employed a cruder tool, the aquaphone.

By Donald Dale Jackson

It takes a 'sixth sense' to operate underneath the streets of New York

Finding room for expansion in the tangle of tubes and utilities below Manhattan requires the intuition, skills of a surgeon

Dave Cornish is a genial, bushy-browed man in his late 50s with an Irish face and a bulge just north of his belt buckle. People tend to make way for Dave on Manhattan sidewalks, and once, back when he wore his hair in a crewcut, he reduced a roomful of party-goers to silence by simply striding through the door. "They thought I was a cop," he laughs. "It's the same way with taxi drivers. Happens all the time."

His colleague Ed Moloney, who is certifiably Irish (which Cornish is not) and about the same age, has the weary, careworn look of a man whose bedroom adjoins an all-night laundromat. Ed customarily moves at an unhurried pace bordering on stately, and he chooses his words the way he chooses where he treads, with care and deliberation. Like Cornish he has an air of quiet competence about him, and like Cornish he usually has a cigarette in his hand.

Cornish and Moloney have spent much of their working lives in the employ of Arnold Vollmer, a gracious and sophisticated New Yorker of impeccable manners whose company, Vollmer Associates, has long been one of the city's leading engineering firms. These three—the affable Cornish, the fastidious Moloney and the elegant Vollmer, who is now semiretired—share an expertise in a subject that to most Big Apple dwell-

Color photographs by Brian R. Wolff

Found during 1912 construction project, pneumatic subway car occupies tube built surreptitiously in 1870.

In early rendering of a New York manhole, a worker services cable while assistant runs ventilation fan.

ers is as mystifying as it is crucial to life in the city: they are authorities on the workings of underground Manhattan, specialists in the tangled thicket of pipes, conduits, mains, tunnels, tubes, ducts and cables that wind beneath the streets of Gotham and keep it humming. They know their way around the subbasement of a city that never stops digging and never stops building, and they have learned to maneuver amid congestion often surpassing that on the surface.

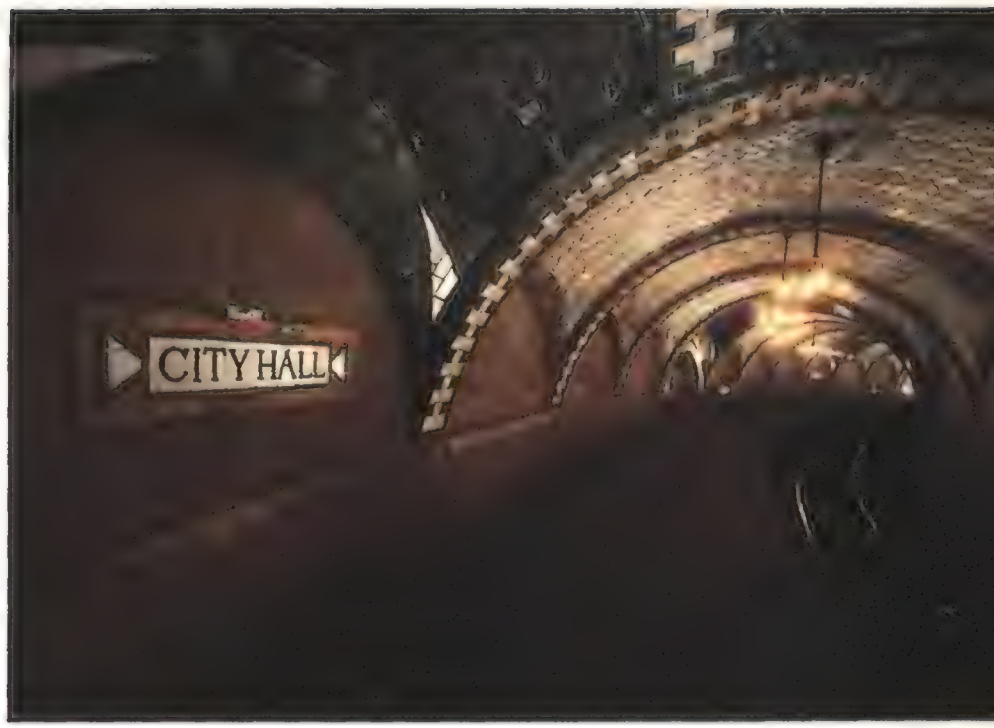
Vollmer got into the underground business almost accidentally. The engineering and landscape architectural firm he launched in 1956 had a contract to plant trees for the city. "To plant a tree in New York you need an OK from any utility in the area, so I was corresponding regularly with utility engineers," he recalls. The phone company asked him to study and design a new duct bank in the early 1960s, and soon afterward contracted with Vollmer to draw plans for the long-distance cables beneath 2,000 Manhattan intersections. As the firm's subterranean savvy deepened, it took on more jobs as engineering consultant to developers and government agencies. Its archives grew until they contained virtually every map or record ever executed of underground New York. Though they are subsurface specialists, the company's 350 employees in six offices from Illinois to Boston also design highways and conduct traffic studies.

Vollmer engineers work with the agencies that run New York's water, sewerage and subway systems and with utilities like Consolidated Edison (whose street-repair signs proclaim "Dig We Must") as well as private builders. They plan and supervise projects that involve adding or relocating underground facilities. They do not do the actual construction work, but they produce the plans that guide the contractors, and they regularly visit ongoing projects. "It's like when you get a model kit with instructions," engineer Stu Lerner explains. "We make the instructions."

Plunging into the spaghetti

At any given time the Vollmer firm is involved in 15 to 20 projects beneath Manhattan. One recent job involved linking two subway stations two blocks apart in connection with the construction of a new Lexington Avenue office building. Another called for the creation of a pedestrian passageway from a huge new Wall Street building to an existing subway station, an assignment that required replacing some old utility lines and moving others. Vollmer workers frequently plunge into the subsurface spaghetti to direct the installation of banks of phone lines for new buildings. Often the grittiest part of the job is finding room for yet another phone duct or a relocated gas or steam main. It's a business where surprises—the discovery of

Open door reveals decompression chamber used by men who built first subway tubes under the Hudson.



Original City Hall subway station has been closed since 1945, but elegant ceiling and mosaics still shine.

unmapped, forgotten or otherwise unexpected phenomena in the city's understory—are part of the daily drill.

"It doesn't matter how carefully you plan, you're still never sure what you're going to find," Vollmer says. "On the surface, short of a hurricane, you're not going to run into any surprises. But underground it's a surprise when there are no surprises." "The records will show a sewer or an electrical conduit under a street," Cornish adds, "but they won't give the specific horizontal or vertical location. A manhole tells you where a line is but not which way it goes. A lot of the time you're working by feel and intuition."

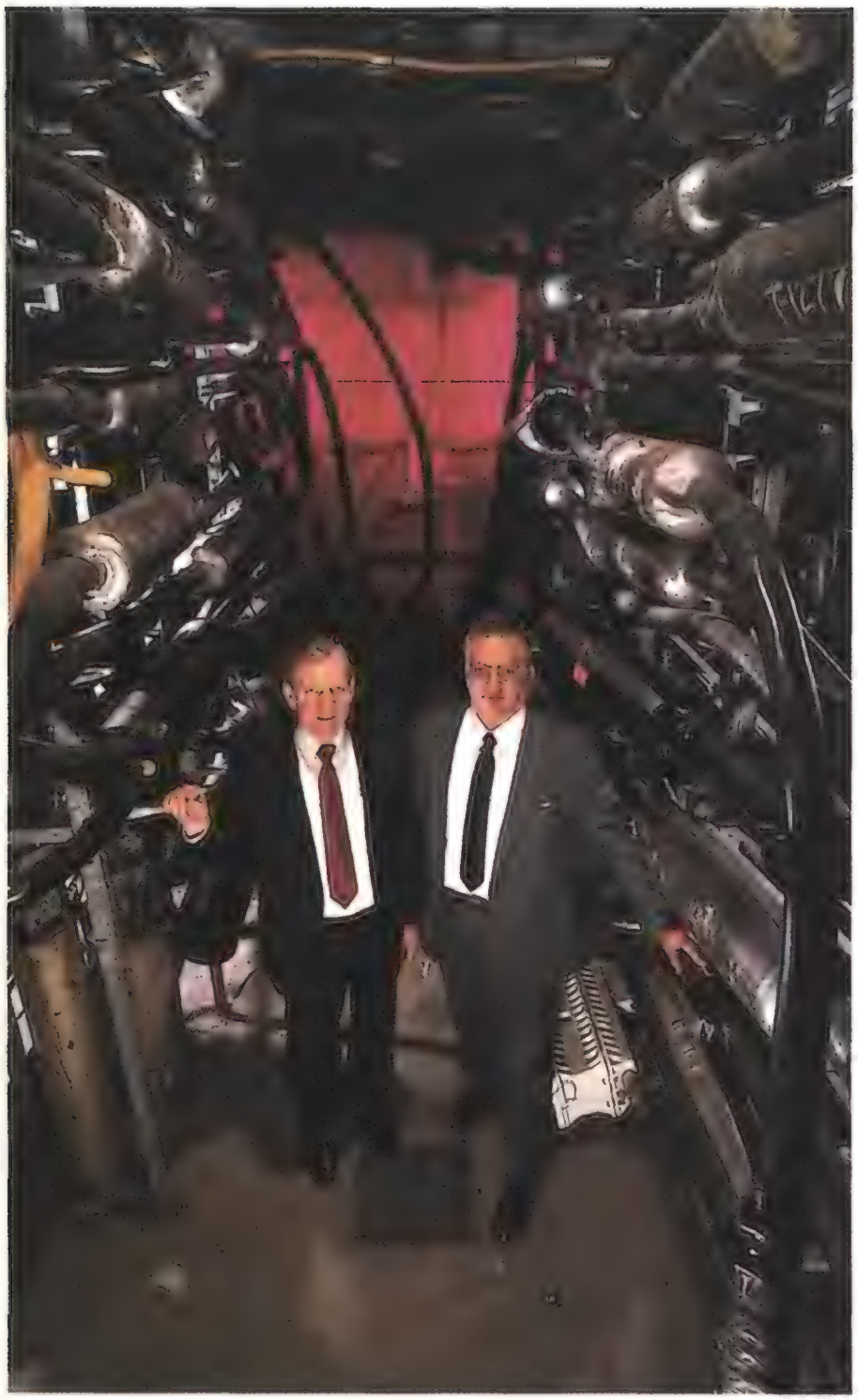
Part of this perpetual uncertainty is the result of shortsighted record keeping that failed to keep up with the city's growth. The records of some early underground facilities were lost or discarded when companies went out of business. Streets were moved, streams and canals filled in, tunnels bored and later abandoned. But other subterranean revelations reflect the city's rich history. There are 18th-century ships down there under filled land near the rivers, and mysterious vaults, the bones of Indians and God knows who else, and the remnants of underground dreams that became subterranean follies.

"We were working on a condo job downtown one time," Cornish recalls, "when we found a bunch of decorative wrought-iron columns eight or nine feet high, arranged in a pattern. It looked like it might have been some kind of arcade. This was three or four feet beneath the surface. We never found out why they were there." Another time Cornish and his crew came upon a hank of foot-long black hair in a test pit several feet down. "It wasn't a rag mop, I'm sure of that," he says. "I didn't look any closer. If there was a skull attached to it, I didn't want to know about it."

Cornish, Moloney and other Vollmer engineers see themselves, in Arnold Vollmer's graceful phrase, as custodians of New York's "tribal memory," underground division. "From our experience and what we've learned in the trenches we have a kind of sixth sense of what we're likely to run into down there," Moloney says. "We know how deep the phone ducts are and the kind of bends the water mains took in the old days." They know the location of the hollowed-out tree trunks used as mains by Aaron Burr's pioneering water company in the early 1800s, and the old brick sewers mortared with lime mud that disintegrates when exposed to the atmosphere. They know where the trolley tracks that once ran along the north-south avenues have been paved over, and where abandoned tunnels persist as boulevards to nowhere.

The most remarkable of those remnant tunnels stands as an invisible monument to a genius whose dream—New York's first subway, a 312-foot-long pneumatic tube—was killed by politics and buried by apathy. It was in 1870, 34 years before the city's initial subway was officially opened, that an inventor-lawyer-publisher named Alfred Ely Beach secretly bored a 9-foot-diameter tunnel under a block of Broadway near City Hall. Beach's men worked furtively at night to avoid paying tribute to William (Boss) Tweed, who

Among Mr. Jackson's most recent contributions to SMITHSONIAN *have been articles on alligators, writer Louis L'Amour and the city of Indianapolis.*



Subterranean specialists Ed Moloney (left) and Dave Cornish visit a vault full of Manhattan phone cables.

ran the city as a private fiefdom in those years. When the tube was finished Beach went public, hosting a grand reception at which his single, 22-seat car was whooshed along by a large steam-powered fan that alternately blew it forward and sucked it back. The spacious waiting room was particularly handsome, featuring settees, paintings, a piano and a fountain issuing from a basin filled with goldfish.

Beach's plan to expand his demonstration line into a subway running the length of Manhattan began to unravel as soon as the wily Tweed got wind of his impertinence. While adventurous New Yorkers happily took 50-mile-an-hour joyrides at a quarter a head, Tweed's man in the state house, Governor John T. Hoffman, vetoed a bill authorizing the subway. Hoffman was soon afterward voted out and Tweed was jailed for graft, but by that time the public and prospective backers had lost interest in Beach's marvel. The tunnel was sealed and it was *sic transit* for the Beach Pneumatic Transit Company. New Yorkers forgot about it until a work crew building the BMT City Hall line found it in 1912. The little rounded car, dust-caked and forlorn, still sat on the tracks (p. 40).

The Lower Manhattan Expressway is a modern variation on the same theme, a grandiose subterranean project that endures today as a 67-foot-long, 6-lane tunnel sealed at both ends. The expressway was abandoned in the late 1960s after the tunnel had been built beneath a subway line on Christie Street. "There are stubs of the subway system all over the city," Ed Moloney points out, ghostly dead-end spurs that were once somebody's good idea. An 1,800-foot-long railroad tunnel under Atlantic Avenue in Brooklyn, built in 1844 and closed in 1860, remained unviolated for more than a century before a young engineering student found it in 1980.

Dissecting the ganglia below

Excavating a Manhattan street and finding an opening amid the ganglia below is delicate work. Sewers, graded for gravity flow, usually occupy the deepest slot. Water mains, gas lines and steam pipes cluster above them. Electrical conduits and phone cables, often encased in concrete, are nearest the surface. Other pipes and ducts—pneumatic tubes once used by the Postal Service, Western Union and the Treasury Department; police- and fire-alarm systems; subway service pipes—weave between and around the rest.

To a fugitive from the surface world, an underground construction site seems like a cave filled with unidentifiable structures angling off in various directions. Two rust-coated electrical conduits are suspended from the street-level planks that form the cavern's roof. A vertical slab of masonry on one side

Cavernous valve chamber of a new water tunnel lies 250 feet below ground in The Bronx. It is 620 feet long and 44 feet wide. Valves in row of 17 lateral connectors control flow, destination of water in tunnel.

of the 150-foot-long corridor turns out to be one wall of an abandoned coal chute. A large pipe perpendicular to the rest, which crosses the corridor, is a sewer-line connector. The place has a strange bluish light at the end open to the outside, where a large blue curtain has been hung to keep out the weather. A little swirl of dust and gas collects near the roof of the tunnel, and there is an occasional whiff of sewage. Ladders, tools and plank walkways clutter the narrow workspace. At the point where the corridor ends, a dozen pipes and conduits of varying sizes disappear into a solid 12-foot-high wall of New York dirt.

Crews drilling a test pit at the outset of a job have to go easy with jackhammers to avoid puncturing a line. "We'll hack away a little concrete at a time," Dave Cornish explains. "There are times when you can't get a shovel between the pipes. We'll use mason's trowels. You end up scraping with your hands."

The engineers who regularly confront this congestion must fight the temptation to recoil in frustration and declare permanent gridlock. "You feel like putting a cap on it," Moloney says. "You want to say, 'Enough, let's stop.' But then you remember that they probably said the same thing a century ago. There were stories in the 1850s about how bad the congestion was. Maybe it's no worse now, relatively, than it was then." "We continually wonder how we're going to get one more thing down there, but somehow we do," says Vollmer. "Sometimes the longest way around is the shortest way home, maybe the only way." The trick is to find a route that gets the job done while minimizing expense and above-ground aggravation. It often comes down to a matter of inches.

"We have a job downtown that calls for a new subway stairway in a place where there's a 46-cable telephone bank," says Dan Greenbaum, president of the Vollmer firm. "If we had to move that bank it would involve resplicing hundreds of thousands of wires. It would probably take nine months and cost more than a million dollars. But we think there might be enough slack in the cables so that we can pull them a couple of feet to the side, enabling the stairway to go in. We try to sneak them in wherever we can."

Moloney and Cornish worked on a project that involved the installation of phone lines to and from a new switching station on the West Side. The only straight-line land available for the new conduits, they discovered, was occupied by trolley tracks that had been paved over, and a trolley turntable sat in front of the building. Once again the long way around turned out to be the shortest way home: they detoured the lines around the turntable and ran one new conduit a block north.

The underground undertakings that stretch an engineer's imagination can be excursions into the city's past. Cornish was drilling a test pit on the Upper East Side some years ago when he penetrated a brick-walled tunnel with narrow-gauge rails on its floor. It turned

A workman digs up Orchard Street on the Lower East Side in order to make repairs on broken water pipe.

Accustomed to crowding, employees of Empire City Subway use ropes to hoist telephone lines out of way.

out to be a minirailroad that a neighborhood brewery had used to convey coal from an East River pier to its furnaces. Vaults of various types frequently turn up. Beneath an office building Cornish encountered one with mirrors on the ceiling and walls—evidently somebody's playtime hideaway. Another, under the Manhattan side of the Brooklyn Bridge, once sheltered a stone Madonna in a niche in the wall. An impious visitor had inscribed a bit of underground philosophy nearby: "Who loveth not wine, women and song, he remaineth a fool his whole life long."

Since 1977 the city has required developers seeking special permits for construction to subsidize archaeological digs on sites, especially in Lower Manhattan where research indicates that historical artifacts might be found. Contract archaeologist Ed Rutsch supervised one dig beneath a new building-and-subway corridor, the latter engineered by the Vollmer staff, on Wall Street. "I was hoping to find remnants of the original wall the Dutch built," Rutsch says. "It was mainly a 12-foot-high wooden palisade, but they might have used stone in some sections." His search ended in disappointment, but he did turn up a beautiful tea set—a hand-painted teapot, creamer and sugar bowl that someone had dumped into an early 19th-century privy. "My question is, who threw it away?" he says. "Was it a disgruntled servant getting even with his boss? Did some company go under and junk it?" Rutsch also found an 1842 five-dollar gold piece in the same place. "That's a hell of a thing to drop in the latrine," he says. "Back then it probably would have paid the rent for a month."

A 1982 dig at a downtown site near the East River yielded an 18th-century British merchant ship that had been sunk as fill. Dr. Sherene Baugher, an archaeologist on the staff of the city's Landmarks Preservation Commission, found pottery and glassware in the ship dating to the 1750s. Baugher was also called in when laborers excavating the floor of a church in the financial district found several human bones. She concluded that the departed were either Indians or Methodists, explaining that the site was once a Methodist cemetery and before then it may have been an Indian burial ground.

Dave Cornish and his colleagues have escaped the catastrophes that sometimes befall men who work un-

Their job is to install a new water pipe underneath the phone lines without interrupting customer service.

Construction proceeds 500 feet below the ground on tunnel that will bring more upstate water to city.

derground. They normally labor in open trenches or beneath planked decks that preclude a buildup of volatile gas from a leaking main. "If there's any sign of danger, we'll shut the job down," Cornish says.

A crew excavating a BMT subway tunnel near Seventh Avenue and 23rd Street in 1915 was not so lucky. Disaster struck the BMT tunnel when a dynamite charge fired by a laborer named August Midnight splintered a street-level wooden deck and a row of timbers supporting it. As the street sagged and collapsed, a wooden trolley car on the deck pitched into the abyss, killing two passengers and crushing five workmen trapped below it. A contemporary newspaper account reported that the trolley "crumpled like pasteboard" when it smacked into the tunnel floor. Dozens of men have been killed in explosions and cave-ins beneath Manhattan's streets over the years, and the perils persist: 21 have died since 1970 during the construction of a new tunnel designed to bring more water into the city from upstate reservoirs.

The most famous subterranean troubleshooter in New York's history—troublesniffer would be more precise—was the legendary James Patrick (Smelly) Kelly. As described by Robert Daley in his book *The World Beneath the City*, Smelly possessed a nose of such unparalleled sensitivity that for years the IND subway line employed him as a full-time leak detector. At the first sign of a stained wall or a peculiar odor, the call went out for Smelly. His olfactory range extended well beyond gas. On one occasion recounted by Daley, the Irish-born Smelly was summoned to trace a strange stench in the 42nd Street IND station. Smelly flexed his nostrils and shortly reached his conclusion: "Elephants." When his report was greeted with skepticism at subway headquarters, Smelly nosed through the archives and learned that the station was below the site of the old Hippodrome, where performing pachyderms had once trod the boards. A water main had broken and saturated a long-buried deposit of elephant dung, and the resulting fumes had permeated the platform. Smelly, who took his vindication in stride, eventually directed a squad of six assistants who detected an average of eight leaks a day.

Human intruders have been known to penetrate off-limits venues in the New York underground. One derelict set up housekeeping in a Con Edison cable

vault on the Bowery a few years back, and a group of uptown hoboes colonized an abandoned railway platform beneath Park Avenue in the 1950s. But the interlopers that most perturb Cornish and company are the city's numerous Norway rats. A creature encountered in the shadowy depths may well grow in the telling, but Cornish swears that one rat he met in an abandoned tunnel was cat-size or maybe fox-size. "I mean he was big," Cornish alleges. "We were carrying strips of steel, but even so we figured that was his territory and we'd leave it to him."

As to the persistent subject of alligators in the New York sewers, Cornish is a firm disbeliever. "I've never seen one or known of one in the sewers," he states categorically. Chroniclers of underground New York differ on this issue. Robert Daley was told by onetime sewer superintendent Teddy May that dozens of 2-foot-long alligators turned up in the sewers in the 1930s, an era when baby gators, like turtles, were sold as pets. May even claimed that sewer inspectors armed with .22 rifles bagged a few. Pamela Jones, author of *Under the City Streets*, dismisses this as "poppycock and balderdash." Jones contends that the grand total of gator finds in city sewers stands at two, and that both were "pitiful 2- to 3-inch specimens."

But if a gator presence in Manhattan's cellar is no more than an enduring fantasy in the urban imagination, an odd assortment of other phenomena, animate and inanimate, has turned up below the streets. A 7-year-old boy once fell into an open sewer manhole on Third Avenue and rode the fast-moving current for half a mile before he was discharged, grimy but unharmed, into the East River. Laborers rebuilding sewer pipes during the Depression supplemented their pay with the coins they found. Teddy May once retrieved the dentures a bibulous New Yorker had lost down a street drain, and on another occasion he recovered a box containing $35,000 in negotiable securities. Con Edison crewmen were once ordered underground to search for one of Elizabeth Taylor's numerous diamonds, and another time they found a gun believed to be a murder weapon.

Vollmer operatives are often dismayed by the average New Yorker's sublime ignorance of things underground. "Very few people have the slightest idea of what makes a single building work," Ed Moloney contends, "of what's there and where it comes from, how the lights go off and on and how water comes out of their faucets." The vast grid of electrical transformers, gas pipelines, sewage plants and other essential facilities functions out of sight and out of mind, except when there's a glitch.

It was big-time congestion, combined with the great blizzard of 1888, that drove many of the city's lifelines underground in the first place. Phone and telegraph cables and many electrical lines were originally strung on poles, some of them 60 and even 90 feet high. Downtown Manhattan looked like a vine-choked urban rain forest. When the blizzard blew many of the power lines down, strewing dangerous live wires across the streets, the utilities went permanently under cover. Surface transportation, by trolley and elevated railway, was also the rule in the 19th century. The first subway opened in 1904, amid a burst of municipal revelry followed by an attitude of blasé nonchalance. Even on opening day, a newspaper reported, New Yorkers got off and on the new subway "in the most natural and matter-of-fact way."

The city's restless growth and constant change explain the absence of an overall master plan for subterranean construction. "You can make master plans in a dream world," Arnold Vollmer says, "but in the real world you fight for space and put a new facility where you can." Thus the engineers who continually rearrange Manhattan's innards must work piecemeal, attacking problems as they arise.

Given its congestion and tangled density, its age and the number of unknown and obsolete phenomena that share its space, it borders on the outlandish that New York's underground network continues to function as well as it does. But Dave Cornish, who has been descending into deepest Manhattan for more than 30 years, is not sanguine. "I don't go underground any more than I have to," he says. When he leaves the office each day, Cornish either walks or takes a bus to Penn Station. He'll pass on the subway. He may know something we don't.

Equipped with breathing packs, city technicians use video equipment to check the sewer system for cracks.

"Laughter, Tears, Passion, Friendship, Love."

De Beers

A diamond is forever.

National Gallery, London

Delicacy, power, sweep and fire of Turner's genius are evident in *The Fighting 'Temeraire' tugged to her*

last berth to be broken up, 1838. A favorite, he once referred to the grand painting as "My Darling."

By Israel Shenker

At long last, Britain's Turner Bequest finds a proper home

Shunted about for more than a century, a trove of his own art left to the nation by painter J. M. W. Turner is finally given a new gallery

With searing color he painted a world of steam and speed, storm and fire, chaos, void. Then, with nothing more than ink and paper, leaving that world behind, he created even greater havoc. In oils and watercolors, Joseph Mallord William Turner (1775-1851) became Britain's greatest painter. But in his will leaving the works to the nation, he went a bit far.

What was the government to do with 300 oil paintings that Turner insisted should remain together in special rooms to be added to the National Gallery and called Turner's Gallery? What about the 19,000 drawings, the almost 300 sketchbooks, the palettes, paints, brushes, guidebooks and model ships? It was more than Britain had bargained for. Authorities turned a blind eye to what became known as the Turner Bequest. A curator at the National Gallery said that many of the paintings were "mere botches" and the bulk of the drawings "of no value whatever."

From that day to this, Turner's eminence in the gallery of great artists has increased, and now, 136 years after his death, his will has finally had its way: a pantheon for his art, joined to the Tate Gallery beside the Thames in London.

In matters of art, attribution is no small problem, and the new building is named not Turner's Gallery but the Clore Gallery. Tycoon and art collector Sir Charles Clore (1904-79) was an artist in his own right—of the hostile takeover. The art he favored was on share certificates and bank notes, and his commercial empire included everything from shoe companies to

Although undated by Turner, experts say self-portrait was done about 1798, making him 23 at the time.

Selfridges department store to Garrard, the Crown Jewellers. In 1980, his daughter, Mrs. Vivien Duffield, arranged for the Clore Foundation to give the Tate £6 million (then almost $14 million) to accommodate the Turners and her father's final takeover.

Glasgow-born architect James Stirling, a Pritzker Architecture Prize laureate, designed a three-story L-shaped building with eight main galleries for oil paintings, three reserve galleries for the overflow, and one gallery for watercolors. Originally planned for completion in 1984, the building took seven years. "It's a very sophisticated gallery," suggests Tate director Alan Bowness. "We wanted to get it right."

It was decided that in order to show the pictures in the light in which they were created and originally viewed, it was desirable to provide daylight for the maximum amount of time, supplementing it only when necessary with artificial light. Contrary to prevailing opinion that light should be predictable and even, it was also decided that it should be unpredictable and uneven—like daylight itself. The solution was to provide the roof with adjustable, reflective louvers, or light "scoops," which would eliminate direct sunlight and deflect the light into the rooms and onto the canvases. Computer-controlled, the aluminum louvers open and close automatically to admit varying intensities of light calculated on an annual basis.

"We're showing everything from the most beautiful finished paintings to the most inconclusive and inscrutable scraps," says Andrew Wilton, curator of the Turner Collection. In one room, to signal that some works are sketches, he has removed their frames. "Turner would have been horrified at the paintings that he hadn't finished being shown," says Bowness, who appears quite unhorrified.

In the eight main rooms, canvases are hung against a light beige background; in the reserve rooms, in tiers against a dark reddish background. Wilton wanted dark walls throughout. "Against a dark background, gilt frames look opulent," he argued. "Against beige they look what they are—cracked and dirty. The beige deadens everything; it blackens dark paintings.

Main entrance to the Clore Gallery invites viewers by way of a garden, a reflecting pool and terrace.

Natural light, supplemented by artificial, is guided by light "scoops" along ceiling of the central gallery.

Dark walls make them luminous—they glow. It seems to me irresponsible—or at least whimsical—to have them on anything else."

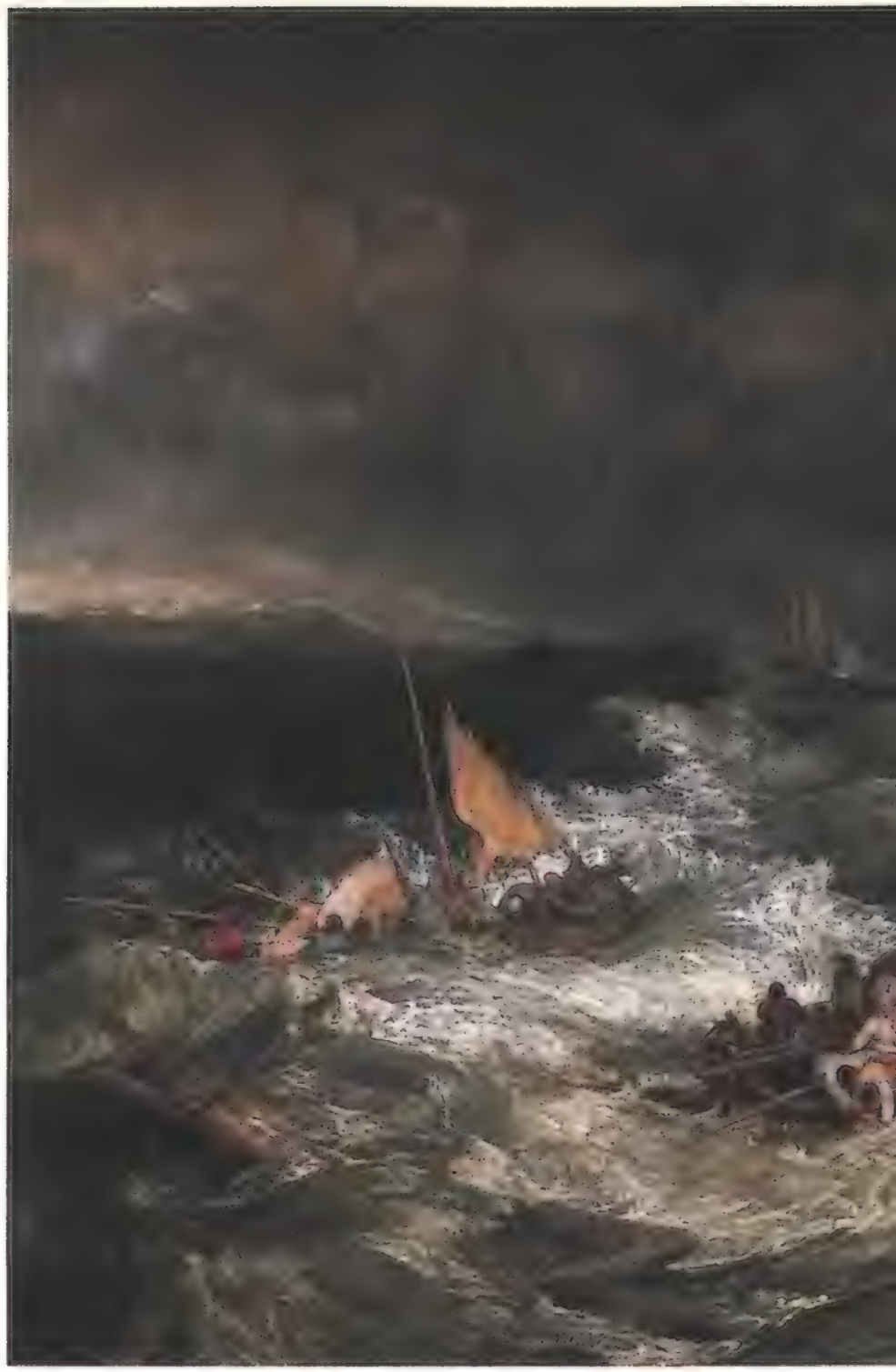
Bowness and Stirling thought that beige worked at the Yale Center for British Art, and would do nicely in London. Notes Bowness: "One is looking for the right blend, that gives the right feel for today and yet is not hostile to the pictures." Wilton was overruled. He smolders on, luminous, glowing.

The new gallery shares the site of an old hospital complex and the former Millbank Prison, Europe's largest prison when it opened in 1816. Millbank was demolished in 1892 and the Tate opened in 1897. During construction of the Clore Gallery, underground cells called "the dark" came to light; through a quirk of British Civil Service terminology, the Tate, like other museums, boasts warders and keepers, as though the art were incarcerated. Unwittingly, part of the new building viewed from inside back toward the entrance looks like a prison. Wittingly, to provide a controversial touch, Stirling has outlined the interior entry arch in turquoise and ultramarine.

A barber pole would have been less garish and more appropriate. Turner was the son of a barber whose shop was near Covent Garden market. The boy's drawings were in the window, offered for sale—price a few shillings each. After working as a draftsman for architects and for a topographical draftsman, Turner became a student at the Royal Academy. When he was 15, he had a watercolor accepted for a summer exhibition there, and soon his oil paintings at the annual exhibitions were drawing acclaim. He taught art briefly and at 24, the minimum age, became an associate member of the Academy, at 26 a full member, and five years later its professor of perspective.

In formal settings, as during his rare lectures, Turner was hard to understand—"almost perfection in mumbling and unintelligibility," suggested one listener. In conversation with friends his diffidence

American author Israel Shenker lives in Scotland. He last wrote on Esperanto in the January 1987 issue.



Of his masterful seascapes in every mood of nature, *Shipwreck*, dated 1805, was one of the most popular.

dropped away and he expressed himself tersely, even epigrammatically, with humor.

"Shy, proud, and reserved," art historian A. J. Finberg called him in what became the standard biography. "There is nothing picturesque, romantic or exciting either in his character or in his life," Finberg wrote in a letter to his son. "His virtues and defects are all on the drab side. He was thoroughly plebeian. . . . A common workman and tradesman . . . the only interesting thing about him is that he was the man who painted Turner's pictures."

In Britain's class-ridden society, Turner sought advancement and recognition through his art, and he worked relentlessly. On sketching tours he recorded the splendor of the English and Welsh countryside, the rugged beauty of the Scottish hills and moors. Buildings, ruins, landscapes, seascapes, crowded harbors, the grandeur of mountain and waterfall, the slow, meandering beauty of rivers—all found new luster in his drawings.

Turner's lifelong fascination with the elemental forces of nature led him inevitably to the great power and limitless moods of the sea. As a boy he had spent holidays at the seaside along the coast of Kent and his interest was undoubtedly aroused there. He was also vigorously patriotic and his focus on naval subjects, beginning in the mid-1790s, coincided with the wave of enthusiasm for Britain's maritime ventures at the beginning of the French wars.

Wealthy patrons inundated him with commissions, and before long Turner had more orders than he could fill. He produced a flood of material for engravings and watercolors, and experimented ceaselessly with new techniques and materials. For drawings in Scotland he used white paper with yellowish-brown washes of India ink mixed with tobacco juice. In watercolors he would lighten portions by drawing a wet brush over dark-colored ground, applying a blotter and finally rubbing with bread crumbs. To get a desired effect, he was prepared to use either end of the brush, as well as his thumbnail. Long before it became fashionable, he would put his fingers into the paint.

With the 1802 peace between Britain and France, Turner traveled to Paris to see Napoleon's great booty of art. In the Louvre he studied works by Titian, Rembrandt, Raphael, Poussin, Correggio, Domenichino, Ruisdael and Rubens, meticulously noting their merits, analyzing their errors. He traveled through France, sketched the majesty of the Swiss mountains, the delicacy of the lakes. To the calm grace of bucolic idylls he added the catastrophic turns of invincible nature —skies that menaced, a crushing avalanche, waters roiled by wind and tide, volcanic upheavals, deluge and plague. Within swirling vortices, all of Creation flared its threat to helpless Man.

It was quickly admired and soon became the first of his works in oil to be reproduced by engraving.

He had painted imaginary Italian landscapes, but in 1819 his first trip to Italy brilliantly informed his palette. Overwhelmed by the light, his work emerged from obscure vales into resplendent pastures. Sunlight's intensity pierced veils of shadow, curtains of mist, heaving foam, the very substance of rock. With the artifices of an intoxicated alchemist, Turner transmuted primary colors into chilling glories and radiant peril. The topographer's exact eye gave way to the innovator's delight in cosmic energy, vibrant light and color, with objects subdued, vaporous, dissolved.

After visiting Venice, Turner painted ethereal, dreamlike prospects in which mass was converted to energy and colors took shape as light. One admirer suggested that his brush was dipped in sunbeams. "He seems to paint with tinted steam, so evanescent, and so airy," commented John Constable, the great landscape artist who was Turner's contemporary.

Theory intrigued Turner, but reality seized him whole. During 40 years he braved the hazards of nature and criticism to learn how the world was made and unmade, how it could be conveyed in pigment and shape and formlessness. Relentlessly he pursued his vision in Germany, Austria, Belgium, back in Switzerland, France and Italy, with eye alert and pencil ready. "Every glance is a glance for study," he declared. It was said of him that in a train speeding through the rain he sat with his head outside the carriage to capture the experience for canvas. And he claimed to have endured four hours in a storm at sea lashed to the mast, not expecting to survive but seeing for himself. "Soapsuds and whitewash," a critic wrote of *Snow Storm*. "What would they have?" Turner expostulated. "I wonder what they think the sea's like. I wish they'd been in it."

A normal, eccentric Englishman

At age 17, preparing to become the foremost art critic of his day, John Ruskin came to Turner's defense and devoted much of his subsequent writing to the man he called "my earthly Master," with the "eye of an eagle," whose work was the "loveliest ever yet done by man, in imagery of the physical world."

"Everybody had described him to me as coarse, boorish, unintellectual, vulgar," Ruskin noted. "This I knew to be impossible. I found him a somewhat eccentric, keen-mannered, matter-of-fact, English-minded-gentleman: good-natured evidently, bad-tempered evidently, hating humbug of all sorts, shrewd, perhaps a little selfish, highly intellectual, the powers of his mind not brought out much with any delight in their manifestation, or intention of display, but flashing out occasionally in a word or a look."

But not every expert in the 19th century was prepared to swallow Ruskin—or Turner—whole. One complained that Turner left so much to be imagined that it was like looking at a coal fire or an old wall. It was suggested that Turner had loaded a blunderbuss with pigments and fired at the canvas, that he seemed to be running a fever, that the dazzling sunlight suggested yellow fever, or jaundice. The paintings were compared to poached eggs and sausage, to tomato sauce, to lobster salads, to stews with curry rampant.

Object of disaffection, stigmatized as the "Over-Turner," he was a precursor of Impressionism, of Abstract Expressionism, even of action painting. "He's been ten different artists," curator Wilton marvels. "He makes you see and think of a great deal more than the objects before you," suggested Thackeray, artist as well as author. "He knows how to soothe or to intoxicate, to fire or to depress." Constable said that Turner had "a wonderful range of mind" and was

National Gallery, London

In 1844, at age 70, the grand master unveiled this tour de force, aptly titled *Rain, Steam, and Speed—The Great Western Railway,* a striking statement of all his formidable power.

Watery, vapory, golden Venice was a likely place for Turner's talent to flower. He did many paintings and sketches there, including *Venice—Maria della Salute,* which drew only qualified admiration at the time.

"stark mad with ability." Artist Robert Motherwell has spoken of the "tragic" in Turner, artist Sir Lawrence Gowing of the "heroic."

Though he treasured privacy, Turner exhibited his mastery each year during the three or four varnishing days for artists putting the finishing touches to their works for exhibition at the Academy. A short, squat figure in a top hat, shabby dress coat, baggy trousers, he would dazzle colleagues with astonishing performances. On canvases that appeared to be covered in pale, milky mists, he drove fresh paint about, wielding his worn brushes with quick determination, not stopping to view his progress from a distance. At the end he walked briskly away without a final glance, confident that all was well. When Turner painted a correcting touch onto another artist's canvas, a collector purchased the work sight unseen: if Turner thought it good enough to improve, it was worth buying.

His art earned Turner a fortune early in his career and he even established his own one-man gallery. Later he grew so attached to some of his works—he called them his children—that he refused offers for them and bought favorites back. Progeny accumulated while canvases decayed; rain leaked from the roof, dust obscured the surfaces, paintings darkened, flaked, cracked, peeled and mildewed. Never forgetting the poverty of his childhood, never profligate, counting pennies no less than pounds, Turner was quick to suspect people—especially engravers—of taking advantage of him.

Turner's mother, who died in 1804, spent her last days in a hospital for the insane, and his father, to whom he was much more attached, became his faithful factotum. The day after his father's funeral, in 1829, Turner made out his first will and followed it, during the succeeding 20 years, with successive codicils and an entirely new will. He provided, and subsequently revoked, £50 annuities for Evelina and Georgiana Danby, whom he had used as models for tiny painted figures. The girls were born of his zealously concealed liaison with Sarah Danby, a widow, who was left an annuity of £10—likewise revoked. Turner had a subsequent, unacknowledged liaison with twice-widowed Sophia Booth (annuity £150), who had been his landlady in Margate. He installed her in a Thames-side cottage in Chelsea, where he was known as Mr. Booth or the Admiral.

His wishes—however impressionistic the spelling

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A city on a river at sunset, about 1832, was part of an ambitious project to illustrate scenes along the great rivers of Europe. The project was only partially completed. Site depicted here is unknown.

and grammar—were much less ambiguous than his identity. He clearly wanted the bulk of his fortune used to establish and maintain a home, to be known as Turner's Gift, for "Poor and Decayed Male Artists born in England and of English Parents only and lawful issue." He provided also for his art, pristine as well as decayed. Two paintings were to go to the National Gallery and hang between two by Claude. The rest of his "finished Pictures" were for the nation, to be kept together in Turner's Gallery. "What is the use of them but all together?" he asked, and stipulated that if the National Gallery had not established Turner's Gallery within ten years of his death, the paintings were to be kept in his own gallery until two years before the end of the lease, then sold.

Three years after writing the last of his final wishes, he was buried in St. Paul's Cathedral, next to the tombs of Sir Thomas Lawrence and Sir Joshua Reynolds. The great Turner, passed over for knighthood when lesser artists were honored, had come to rest—in time for his legacy to swirl in a litigious vortex of its own. His relatives went to court to claim that when making his will he had not been of sound mind. They lost their case, but went on to pursue it in the Court of Chancery, a jurisdiction of notorious pettifoggery.

Chancery found a technical flaw in the will, and Turner's relatives, for whom he did not wish to provide, inherited his money and property, with nothing for decayed artists. Turner's work—finished and unfinished—went to the National Gallery, where it was not precisely welcome, to be stored in the cellar.

In 1857, Lord St. Leonards, a former Lord Chancellor, insisted that Turner's will still governed and that the National Gallery's trustees should at once remove paintings lent to Marlborough House. That very year the National Gallery's director reported that 102 of Turner's colored drawings were on exhibit at Marlborough House, and noted that drawings "are in time injuriously affected by light." The exhibition was therefore to be temporary. But 50 years later several of the drawings were still on show.

When St. Leonards returned to the attack, in 1861, he asked whether steps had been taken to fulfill the conditions of Turner's will. The deadline was about to expire, so with less than two months to spare the National Gallery removed the Dutch and Flemish pictures from the West Room, crowded 82 of Turner's paintings onto the walls (some had to be removed from

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National Portrait Gallery, London

Caricature of 1846 made point of Turner's love of chrome yellow, which shocked and amused public.

their frames to squeeze them into a top tier next to the ceiling) and put others on screens and in an adjoining office. Signs were posted, inscribed "Turner's Gallery."

More than a quarter of the works displayed at the National Gallery were suddenly by Turner, an imbalance that could not be allowed to endure. Something had to give, so about half the paintings in the Turner Bequest were lent out to provincial institutions.

Unfinished canvases and oil paintings on wood—known as "the lumber"—were considered unworthy of exhibition and languished in the cellar. Sketchbooks and notebooks were stored there in large boxes, known collectively as Turner's "waste-paper basket."

Ruskin, having volunteered his help, began arranging the drawings. To facilitate conservation and cataloguing, he unbound all the sketchbooks and, like the "Recording Angel," assigned grades—*R* was "fine," *M* "middling" and *O* "rubbish." Like an avenging angel, he approved destruction of drawings he considered "grossly obscene."

At the beginning of this century, art historian A. J. Finberg was commissioned to undertake a new inventory, a task not made easier by Turner's execrable handwriting and repeated failure to identify places and dates. Finberg improvised maps indicating Turner's sketching itineraries and judiciously refrained from Ruskinian assaults. He did, however, eliminate many drawings from consideration as being by other artists. Finally, he called on the government to honor the obligations imposed by Turner's will.

An opportunity presented itself with establishment of the Tate, which began as an annex of the National Gallery. All the Turner paintings except 19 of the most important were transferred to the Tate. Since it, too, had a cellar, the works on paper simply changed cellars. Then, with money from art dealer Joseph J. Duveen, who wanted to see the Turner paintings suitably housed, the Tate built an extension, which opened in 1910.

It was only a partial solution. In 1916 the National Gallery's trustees sought government authority to sell "superfluous Turners," but had to rest content with broadened permission to lend the undesirables—abroad as well as at home.

In 1928 the Thames overflowed, flooding the cellar of the Tate. Many of the Turners were inundated, some lost, others damaged, an ironic fate for works by a maritime master. Since the Thames might flood again, the surviving watercolors, drawings and sketchbooks were transferred to the British Museum, which stands high and dry.

Keeping track of the exiles was no easy matter. A batch of watercolors was found in a portfolio at the back of a bookcase in the National Gallery. Some oils emerged from a paper parcel on which Ruskin had put his initials. In 1939, in the cellar of the National Gallery, about 50 dust-laden rolls of canvas, which the director, Sir Kenneth Clark, took to be old tarpaulins, turned out to be oils by Turner.

To celebrate the Turner bicentenary in 1975, a large Turner exhibition was held at the Royal Academy, which led to renewed ardor for the master's genius and to founding of the Turner Society. The faithful began agitating for compliance with the will and establishment of Turner's Gallery. Led by sculptor Henry Moore and supported by poet laureate Sir John Betjeman, the society argued that Somerset House, on the Strand, not far from Turner's birthplace, would be a worthy home for Turner's work. The Tate, independent of the National Gallery since 1955, opposed the proposal. An alternative idea was to convert wards of the vacant hospital, or its site, beside the Tate to receive Turners, many of which needed intensive care.

"The pictures would have disintegrated"

Enter Clore: "How much would it cost?" questioned Vivien Duffield, and gave her approval for what curator Wilton calls the "powerhouse of Turner conservation and scholarship."

Restorers were overwhelmed by Turner and the delicate work of rescue. "They had to reline everything, or the pictures would have disintegrated," notes Wilton. "Quite a lot of paintings have been brought to a reasonable state. One or two have been resurrected from the dead. About 270 sketchbooks have been rebound, sometimes in the wrong order. It's an art-historical nightmare."

There are only four sketchbooks known to be elsewhere, and last year one sold for £528,000 (currently $850,000). In 1984, *Seascape: Folkestone*, a Turner oil that had belonged to Lord Clark, sold for the high-

est auction price paid, till then, for a painting—more than $9 million.

The Tate should have little trouble consoling itself with what remains, housed securely above ground. But militant Turnerites were not entirely enchanted. They had clamored—without success—for an independent board of trustees to supervise the Turner Bequest. And the National Gallery, while lending Turners for the first six months of the Clore display, was going to get them back, despite provisions of the will. There was also that awkward matter of the new gallery's name. And if there should ever be a Duveen Society, its members will surely be upset that in attempting to satisfy Turner's intricate and demanding wishes, the Tate overruled Duveen's. In the aura of inauguration by the Queen (she herself opened the Clore in April), a veil—not one of Turner's—was drawn across all these questions.

"Turner's will is absolutely irrelevant," insists Wilton, speaking of "sentimental distortion." But he adds, probably in jest, "I'm sure the jinx that has attached itself to Turner's will will not go away."

One of Turner's "square" paintings, *Peace—Burial at Sea* is considered to be among his most dramatic. The work was a memorial to Turner's friend Sir David Wilkie, who died on board a ship in June 1841.

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A physicist spends part of his time with the rest of us in the familiar world where things make sense.

But he also lives in a very different place, where nothing behaves the way that it is supposed to.

By James Trefil

Quantum physics' world: now you see it, now you don't

If you have to cope with atomic particles that can read your mind even when they don't exist, it can be hard to explain what you do all day

Some people have it easy. When their kids ask them what they do at work, they can give a simple, direct answer: "I put out fires" or "I fix sick people" or "I do arbitrage." As a theoretical physicist, I never had this luxury. Society has come to expect many things from physicists. It used to be that we only had to discover the basic laws that govern the world and supply the technical breakthroughs that would fuel the next Silicon Valley. With these expectations we were fairly comfortable: they involve the sorts of things we think we know how to do. What bothers us—and what makes it hard for us to tell our kids what we're up to—is that in this century we have become, albeit unwillingly, gurus on philosophical questions such as "What is the nature of Reality?"

We now deal with a whole new class of problems. We ask how the Universe began and what is the ultimate nature of matter. The answers we are coming up with just do not lend themselves to simple explanations.

In the good old days we could explain Sir Isaac Newton's clockwork Universe by making analogies with things familiar to everyone. And if the math got a little complicated, that was all right: it gave a certain panache to the whole enterprise. But those days are gone forever. How is a physicist supposed to find a simple way of explaining that some of his colleagues think our familiar world is actually embedded in an 11-dimensional Universe? Or that space itself is curved and expanding? The math is still there; the theories are as coherent as they ever were. What's missing is the link between those theories and things that "make sense"—things the average person can picture. This leads to a situation where it's easy for anyone to ask questions that can't be answered without recourse to mathematics, such as my all-time least favorite: "Well, if the Universe is really expanding, what is it expanding *into*?"

There's no place where this problem is worse than in the theory that underlies things like digital watches and personal computers. This theory, called quantum mechanics, describes the behavior of atoms and their constituents. It tells us that the world of the physicist is not at all like the world we are used to. When physicists get out of their cars in the morning, have a cup of coffee and sit down in front of computer terminals, they leave a familiar, cozy environment and enter a place where things act in strange, virtually inexplicable ways.

Let me give you an example of what I mean. When you run into a wall, you expect to bounce off. If you were an electron, however, our theories say there is some chance that you would simply appear on the other side of the wall without leaving a hole behind you. In fact, if electrons didn't behave this way, your transistor radio wouldn't work. How do you explain something like *that* to your kids? And what does it tell you about whether the electron is "real" or not?

Don't get me wrong. I don't think that people—even physicists—go around with these sorts of questions on their minds all the time. But as one friend put it to me, "It's not so much that I want to know the answers myself, it's just that I want to know that they're in good hands." It is this obligation to provide the good hands that in this century has been thrust on me and my colleagues.

Confused chitchat at cocktail parties

Physicists get involved in trying to explain these kinds of things because two of our 20th-century theories—relativity and quantum mechanics—have dealt major blows to accepted ideas about what is real in the world. The shock of relativity pretty well played itself out in the 1920s, mainly in cocktail party chitchat that confused relativity (a well-defined theory in physics) with philosophical and moral relativism, with which it has nothing in common except the name. It now looks as if quantum mechanics is about to suffer through its own period of popular misunderstanding, making physicists even more uncomfortable with their role as philosophical arbiters.

Physics has gone from studying familiar things in our everyday lives like tides and baseballs to strange things like atoms and the particles from which they are made: things we do not (indeed, cannot) ever

Illustrations by John Huehnergarth

An electron can pass through a brick wall—an ability that's unfortunately denied to the rest of us.

know directly. Inside the atom we find everything in little bundles called quanta. On the subatomic level, both matter and energy always come in quanta—discrete quantities. An electron can be at one energy level or another as it orbits a nucleus, for example, but never anything in between. Or, that characteristic of the electron known as spin will always be in certain quantities and never anything else. (The singular form of the word, quantum, is combined with mechanics, an old term for the study of motion, to give us quantum mechanics.) The first great difference between the familiar world and the quantum world—the world of the atom—is that we do not "see" things in the same way in the two worlds. This difference leads to results that defy our understanding, such as the electron going through the wall without leaving a hole behind it. The electron, in effect, disappears from one side of the wall and reappears on the other. Nothing in our everyday life prepares us for this.

You probably never thought about it, but when you look at something (this magazine, for example), you're detecting light that has come from some source, bounced off the object and then come to your eye. The reason we normally don't think about seeing in this way is that in our everyday world we can safely assume that bouncing light off a magazine doesn't change the magazine in any way that matters. The light from a lamp does not push the magazine away.

When we get to the quantum world, however, this comfortable assumption no longer works. If you want to see that bundle of matter we call an electron, you have to bounce another bundle off it. In the process, the electron is bound to be changed.

Limited by the Uncertainty Principle

A simple analogy can help with this point. Suppose you wanted to find out if there was a car in a long tunnel, and suppose that the only way you could do this was to send another car into the tunnel and listen for a crash. It's obvious that you could detect the original car in this way, but it's also obvious that after your detection experiment that car wouldn't be the same as it was before. In the quantum world this is the *only* sort of experiment you can do. Therefore the first great rule of quantum mechanics is: *You cannot observe something without changing it in the process.* This is the basis of what is called the Uncertainty Principle: When you choose to observe one thing (e.g., the location of the car in the tunnel) you must forever be uncertain about something else (e.g., how fast the car was moving before the collision).

We usually associate the act of making a measurement with the presence of a conscious experimenter who wants the measurement made. Thus you some-

When he sits down at his computer in the morning, a physicist leaves the rest of us behind. When he comes back, he cannot explain where he has been, or what it is that he has been doing.

times run across the comment that quantum mechanics implies that nothing could exist without the presence of consciousness. From the example of the car in the tunnel, though, it's obvious that this is the modern-day analogue to the old confusion of relativity and relativism. It's the nature of the measurement, not the one who designs the experiment, that introduces the problem.

The inability to observe things in the subatomic world without at the same time disturbing them has some surprising consequences when you start to think about the way that particles move from one point to another. Let's use another automotive analogy. Suppose I asked you to tell me where a particular car will be tomorrow. Ordinarily, you would look to see where the car is, look again to see which way it is going and look again to see how fast. After a moment with your calculator, you would come back with a definite answer. If the car is like an electron, however, you can't look at it more than once—the first look changes everything. You cannot know with precision both where it is and how fast it is going; the best you can do is to play off the uncertainties. You might, for example, be able to say that the car is somewhere in the Chicago area and heading in a generally eastward direction at roughly 40 to 60 miles per hour. You can't be more precise than that without more measurements, and more measurements would only change the car's location or velocity and therefore increase your uncertainty.

If you want to talk about where the car will be tomorrow, then, you have to speak in probabilities—it might be in Cleveland, it might be in Detroit, it might even be in New York. The chances are, though, that it would not be in Miami or London. You could make your prediction, in other words, by giving me the odds of the car being in Detroit, Cleveland or New York after 24 hours. This collection of probabilities is what physicists call a wave function, and it's exactly the way we describe the motion of things like electrons.

Up to this point, you've probably been following along pretty easily, perhaps thinking that you might as well humor this guy as he makes all these obvious statements. Well, hold on, because things are about to become curious. The reason you aren't bothered by having to describe the car in terms of probabilities is that deep in your heart, you *know* that the car is really somewhere all the time, and if you could just peek, you could see it merrily tooling along any time you wanted to. Of course, if you did you'd change it and mess up the experiment, but you have the easy feeling that somehow the car is really there, even if you don't see it. You might even imagine the whole country as an underground parking lot in which you can see the car only at the exits. You may not be able to see the car between exits, but you know it's always somewhere in the garage.

The problem is that physicists don't envision electrons this way. Their view is that until you look at a particle, you have to treat it only as a set of proba-

James Trefil is now Clarence Robinson Professor of Physics at George Mason University. Meditations at Sunset, *his latest book, was published in June.*

Using one car to find out if there is another in a tunnel is messy; similar problems arise inside atoms.

bilities. In terms of our analogy, they say that the car isn't really at any particular place unless it's being measured. In between, it's just a set of probabilities that describe what would happen if a measurement occurred—a wave function.

The idea that there had to be some sort of underlying reality beneath the wave functions and probabilities that physicists use was probably what led Albert Einstein to his famous comment that "God does not play dice" with the Universe. This is a well-known statement, and I only wish that the reply of Niels Bohr, Nobel laureate and longtime friend and colleague of Einstein's, was as well known. "Albert," he is supposed to have said one day, "stop telling God what to do."

Einstein, being Einstein, put his objection into concrete form in 1935 when, along with Boris Podolsky and Nathan Rosen, he published what has come to be known as the Einstein-Podolsky-Rosen (EPR) paradox. This paradox was intended to show the inherent ridiculousness of treating the particle as a set of probabilities between measurements, and hence to imply that the whole probabilistic view of the world was wrong. The argument goes like this: There are some common reactions that result in two particles (like electrons) being emitted back-to-back from the same atom; electrons spin around their axes, and general laws of physics tell us that in this sort of reaction the electrons have to spin in opposite directions—if one is spinning clockwise, the other must be counterclockwise and vice versa.

Einstein applies some common sense

Einstein argued as follows. You tell me that the electrons don't really have a spin, just as they don't have a position, unless they're being measured, but I could let those two electrons travel until they were light-years apart, and then measure only one of them. For example, if you measured the right-hand electron and found it spinning clockwise, you'd know instantly that the left-hand electron was spinning counterclockwise—*without ever measuring it*. The left-hand electron, therefore, must have had that spin all along and you must be wrong about it not being anywhere or having any spin between measurements.

Well, that sounds pretty convincing, but quantum mechanics worked so well and explained so much that most physicists tacitly ignored Einstein and kept on using it. The practical payoffs—from microelectronics to lasers—have been tremendous. But the old problem of reality still rankled. Then in 1964, the Scottish physicist John Bell discovered something that has come to be known as Bell's Theorem. What he found was that in the kind of back-to-back reactions that Einstein talked about, there were certain quantities that were predicted to be different if the electrons were described as being "really there" than they would be if the electrons were described in terms of wave function. What these quantities are is not important (they have to do with the way the axes of rotation of the electrons point in space with respect to the direction in which the particles move). What is important is that with Bell's Theorem we have, for the first time, an experimental way of resolving the problem of what that electron is doing between measurements, the problem of whether it's really there or not. All we have to do is measure some of the quantities Bell talked about and see if they match up with quantum mechanics or with the common sense approach Einstein advocated.

In the 1960s, no one thought the experiments suggested by Bell's Theorem could ever be done; they had

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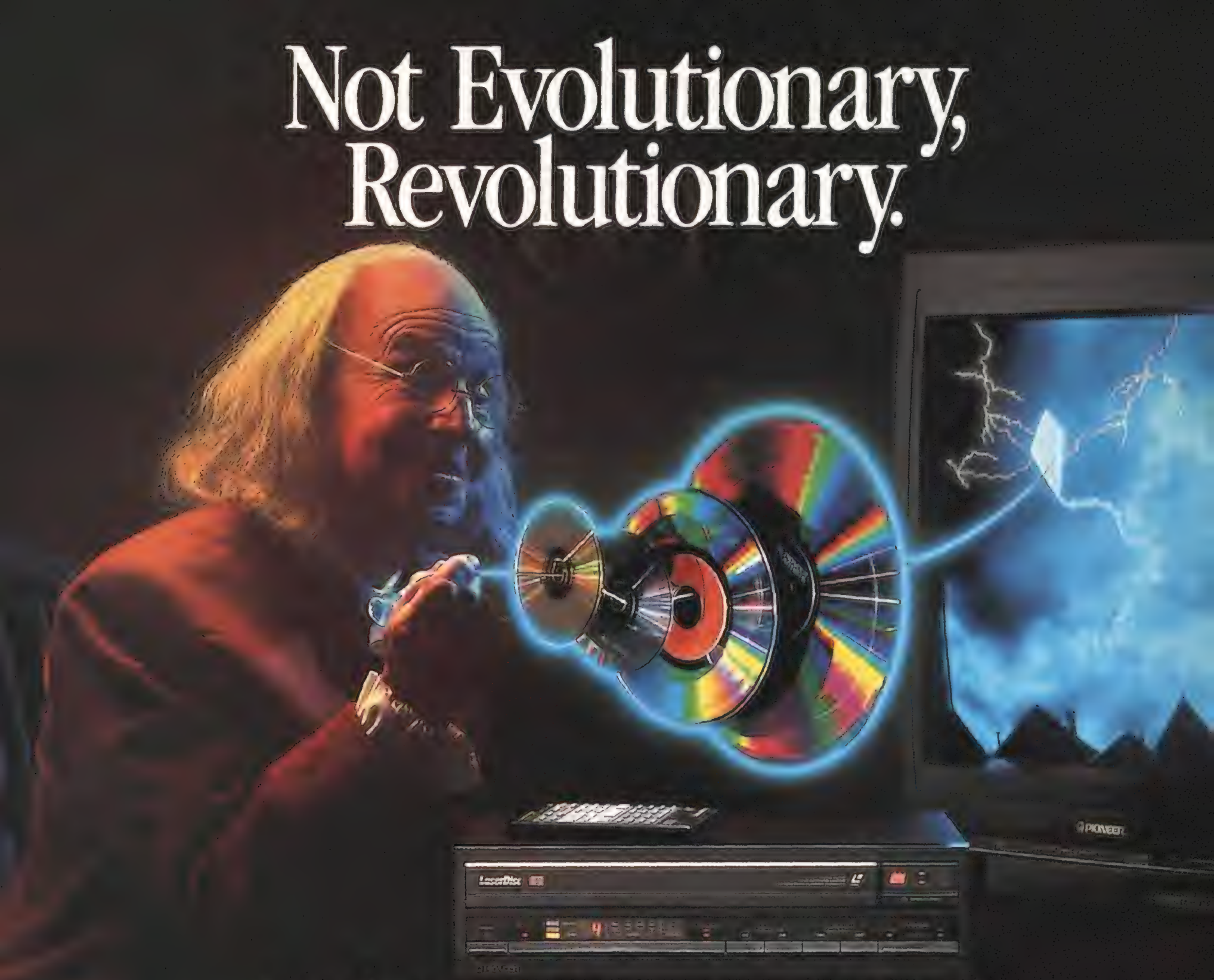

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something of the status of that old sophomore problem of whether a million monkeys at typewriters could ever create *Hamlet*. It was interesting in an intellectual sort of way, but totally outside the realm of practical possibility.

Well, it never pays to underestimate experimental physicists. By the mid-1980s, a large number of EPR-type experiments had been done, and in all cases the results were unequivocal. The standard theory, the one that says that the electron has to be described by a wave function between measurements, is right. The predictions of the theories that say that the electron really has a well-defined spin before it is measured are wrong. Period. The results mean as well that the electron really is not any place between measurements. When you are not looking, it is not there.

How can we understand this? If you try to make a mental picture of what the electrons are doing, you have to say that the left-hand electron somehow knows what experiment will eventually be done—that it

When Einstein said that God does not "play dice," Bohr cautioned him against telling God what to do.

Only recently have experimentalists been able to find out if electrons spin in the ways theorists say.

changes itself depending on what happens to its right-hand partner before it can ever "know" what happened. No matter how transmitted, information—like everything else in the Universe—cannot travel faster than light. Thus in an experiment in which a pair of electrons is produced and they fly away from each other until they are light-years apart, it would take years for the results of measuring the right-hand electron to reach the left-hand electron. But the latter knows instantly.

This result is the crux of the problem in understanding quantum mechanics, and it certainly makes it tough for physicists to explain what they do to their kids. How do you talk about things in simple everyday terms when the particles you're trying to describe insist on acting as if they could read your mind? There is just no way of picturing electrons in any way that makes sense or squares with our intuition.

Having made this point, though, I have to remind you that all of the conceptual problems with figuring out what the electrons are up to have to do with what happens *between* measurements. We can never actually answer this question because the Uncertainty Principle tells us that if we try, we will change everything. Quantum mechanics succeeds beautifully in describing the result of any experiment that you can actually do.

The new wave of quantum mechanical experi-

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Whether a bit of subatomic matter should be treated as a wave or a particle depends on how you look at it.

ments has produced other results that are even harder to deal with than the EPR outcome. For example, one of the old problems in quantum mechanics has to do with something called the "wave-particle duality." In essence, the problem arises because in some experiments an electron acts like a miniature baseball (a particle), but in others it seems to have the property of a wave. In classical physics, waves and particles were all there was, and everything was either one or the other. The ability of quantum particles to assume the character of either, depending on the experiment being done, constituted another of those seemingly inexplicable paradoxes of the quantum world.

Of course, you could argue that electrons were neither particle nor wave, but something different that exhibited the properties of both. Like the standard probabilistic view, however, this is a profoundly unsatisfying solution. It doesn't give a *picture* of what the particle is.

A few years ago several groups in Europe carried out experiments designed to "trick" the quantum particles into revealing their true identity. A particle would be directed toward an apparatus and then, while it was still in flight, the experiment would be changed so that either the wave or particle aspects of the moving particle would be tested. The point is that the particle, in flight, couldn't know what the experiment was to be.

For all the cleverness involved in this setup, the results were exactly as predicted by quantum mechanics: when the particle experiment was done, a particle was seen, and when a wave experiment was chosen, a wave was seen. If you insist on thinking of an electron as something analogous to a baseball or a ripple on water, this result is hard to comprehend. What *is* the electron, anyway, and how can it transform itself while it is in flight?

There are some things we will never know

The sense of frustration you are feeling right now arises because try as we may, we cannot find an intuitively pleasing way to describe what the electron is doing during those periods when we aren't actually looking at it. Does this remind you of the old college bull sessions about the tree in the forest? It should, because the quantum theory of the ultimate nature of matter seems to raise questions that simply cannot be resolved.

Some people, confronted by the sorts of paradoxical behavior we've been describing, have been driven to truly bizarre points of view. In discussing the EPR experiment, for example, some people have argued that the two particles communicate with each other by some unknown process of a kind that could also produce telepathy and extrasensory perception in humans. Others describe a Universe in which everything is connected to everything else. As the poet Francis Thompson put it, "Thou canst not stir a flower/ Without troubling of a star." All this may be going overboard, but it shows how disturbing the physics is.

Many people are surprised that supposedly tough-minded physicists agonize over questions like what the electron is doing when it's not being measured. But the fact is that most physicists think in pictures and have the same intuitive notions that you do. Anything that bothers you, therefore, is likely to bother them as well.

I often wonder if the real difficulty arises because there are limits to what we can know—what we can comfortably absorb. Perhaps we have moved to the limits of what our minds can picture and our intuitions can deal with. Perhaps the problems we have with 20th-century science are tokens of things to come, and in the future everything will be as strange to us as quantum mechanics. I hope things don't turn out this way, but they certainly could.

Over the years, I have talked to colleagues about their reactions to this state of affairs in our science. Some of the answers may be enlightening.

Go Away—Anonymous.

This is far and away the most common reaction. We have a theory (quantum mechanics) that allows us to make the next big technological advance, win the next Nobel Prize. Why bother about questions that can't be answered, anyway?

What's the problem?—Asher Peres, theoretical physicist.

Peres is a man who has thought deeply about the question and has come to the conclusion that the problems are all in the mind. After all, problems arise only when we try to think about the electrons as if they were baseballs. Obviously they're not, and there's no reason to expect that they will be. If we just stick to the rules of quantum mechanics and ignore the demands of intuition, no difficulties arise. The title of one of his articles, "Unperformed Experiments Have No Results," tells it all. I have to admit that I find this line of thought very attractive.

It only bothers me when I think about it—Mike Chanowitz, theoretical physicist.

A typical response of a thoughtful man. It *is* hard to stick with pure logic and give up a lifetime's worth of intuitive knowledge about the way the world really ought to be.

The mind demands more—Bernard d'Espagnat, experimental physicist.

It's not enough to have a theory that predicts what will happen in experiments; it has to give you a coherent and intuitively appealing view of the world as well. I suspect that most of you feel this way.

Anyone who isn't bothered by Bell's Theorem has rocks in his head—David Mermin, theoretical physicist, quoting a friend.

What can I say?

Today's physicists find themselves called upon to be philosophers who can deal with the ultimate question. But in the inexplicable world of quantum mechanics, comprehensible answers are few and far between.

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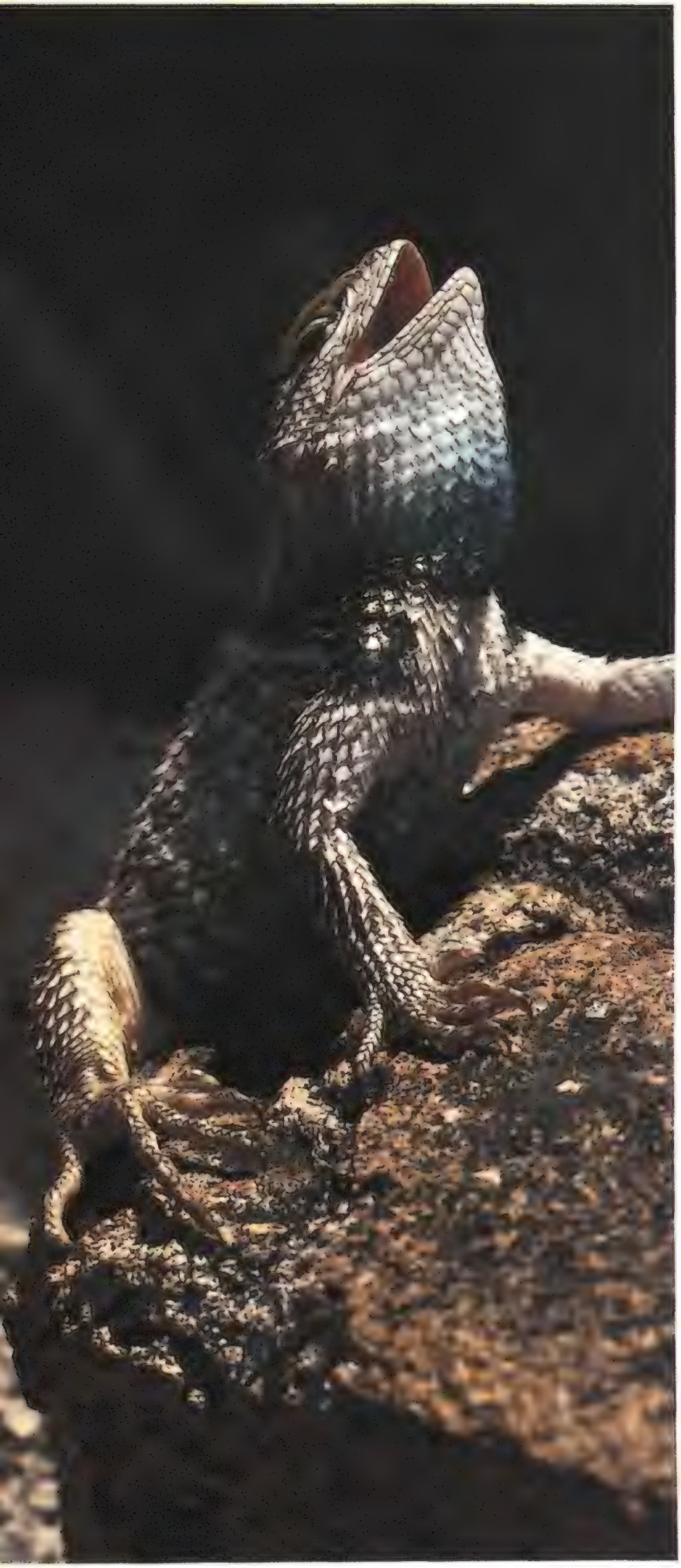

A male desert spiny lizard distends its brightly colored throat in a threat display against an intruding male.

By Bil Gilbert

Lizards that take to the desert like ducks to water

The reptiles thrive in seemingly horrendous conditions, seizing opportune moments and fully exploiting different microhabitats

There is a great deal of talk these days about competition—about how to acquire or reacquire desirable things that, it is widely thought, we are losing to improbable foreigners. Much of it implies that the world at large is an expansion of the National Football League: that the best and natural way for individuals, populations and even species to get what they want is to take them by engaging in and winning contests with others. There is another premise: that this sort of activity is the long-range, evolutionary equivalent of jogging or eating organic. It is claimed that throughout natural history, contests have made contestants stronger and smarter, spurred them on to develop venom sacs, tusks and opposable thumbs—to say nothing of more favorable trade balances.

Much of this talk is very loose. Zoological evidence strongly suggests that for virtually all creatures, direct win-lose contests are risky and inefficient last-resort options for getting things, and are therefore best avoided. To this end many species have developed communicative, social and territorial behaviors aimed at forestalling head-to-head brawls. Confrontations sometimes still occur—no system being perfect—but are, in essence, penalties assessed when natural laws are disregarded rather than being the driving force behind those laws.

A basic and common method for dealing with the risks of contests is to get out of such situations where they are likely to occur. Most creatures locate in places and find unique ways of exploiting them so as to re-

duce the need to vie with others of similar appetites. Biologists call these special fields and modes of endeavor niches. The strategy to avoid rather than engage in contests seems mainly responsible for the innumerable adaptations of most animals—the diversity, possibly the tenacity, of life. Consider the Sonoran Desert lizards. The political, economic and social authorities currently urging us to bear down, suck it in and become more competitive seldom talk about, perhaps don't think much about, these animals. Nevertheless, in regard to the realities of natural competition they may offer a better model than, say, the Chicago Bears or Seattle Seahawks.

The Sonoran Desert is a tract of some 120,000 square miles extending across parts of northwestern Mexico, southern Arizona and California. In it, herpetologists think there are at least 60 species of lizards. The figure is approximate since there are differences of opinion among taxonomists about the proper classification of some of the animals. Also, in this logistically difficult area it is assumed there are probably species not yet described. As the accompanying photographs show, these creatures are an attractive lot, coming in gaudy colors and unusual shapes. Esthetics aside, however, perhaps the most interesting thing about the desert lizards is how various they are, how many niches they have found in this seemingly unpromising place.

A world of harsh, fast-changing conditions

The most dramatic, commonly noted phenomenon of deserts is that they are ungodly hot and dry. This is certainly the case with the Sonoran. Along the lower Colorado River, for example, there are places where surface temperatures approach 200 degrees F and the average annual rainfall is less than three inches, in some years nonexistent. Less obvious than these extreme conditions but at least as ecologically significant is the extraordinary diversity of climates and habitats in these areas: snow-capped peaks, swampy hollows, drifting dunes and scrub plains often exist in close proximity. At the same time environmental conditions can vary drastically from season to season, even hour to hour in the same small location. At noon, rocks on the sunny side of an outcropping can be too hot to touch, while those in the shade are coolish. At midnight the formation may be frosted and by morning submerged under the waters of a flash flood.

Deserts are wildly heterogeneous, composed of numerous, disparate, sharply delineated microenvironments. As a rule their inhabitants are confined to rather small areas and are unsuited for other nearby ones. They make do with narrow resource bases and brief, often sporadic, but frantic activity periods. Gila monsters, for example, big, venomous lizards (p. 81)

Bright orange spots on the shoulders signal that this female collared lizard is receptive toward mating.

Photographs by Thomas A. Wiewandt

Cryptic coloration of regal horned lizard allows it to blend into rocks. Some may squirt blood from eye.

A male zebra-tailed lizard tries to look as large as it can to discourage another male on rocks below.

that support themselves by stalking about the rocky desert scrublands, prey mostly on nestling birds and mammals—but only very occasionally. Students of the species have found that for about 98 percent of the year the surface of the desert is too hot or cold for the Gilas. Therefore they go beneath it into burrows and there, consuming at very low metabolic rates the energy stored in their stout bodies, wait for the two percent of the year when they are able to exploit the resources of their habitat. The Gila is extreme in this regard, but other lizards cope with the desert in somewhat the same fashion. For long periods they do—by the vigorous standards of birds and mammals—next to nothing, conserving their vital resources, hanging on until windows of biological opportunity open, often irregularly and briefly.

There is a theorem of classical logic to the effect that a thing cannot be and not be at one and the same time. It is applicable to the life-style of the Sonoran Desert lizards. Since they are designed, in a sense, to be patient, they cannot be impatient. In response to, say, cold, ectotherms (as cold-blooded animals are known) ration fuel rather than stoke their interior furnaces, allowing body temperature to fluctuate, up to a point, as the environmental temperature does. Survival depends upon slowing metabolic processes (reducing energy intakes and outputs) or, in a word, inactivity. Hibernating mammals make the same responses but on a seasonal basis. Lizards are more flexible, adjusting quickly to daily and even hourly changes in the temperatures of their habitat.

There are limits of patience even for lizards. While inactive they are using, though in a very miserly fashion, energy stored in their bodies. Eventually they must recharge by becoming active, taking food and increasing oxygen consumption to burn it. The conditions of heat at which they best function occur so in-

Black tongue of the Gila monster, one of only two venomous lizards in world, is used to track prey.

It has flattened itself vertically and extended its orange gular (throat) pouch to make itself imposing.

frequently or prevail so briefly in such small areas, however, that they cannot be entirely passive, waiting to do business until their habitat is a uniform 100 degrees or so. To be active enough to survive they must to some extent control their body temperatures. They do so by manipulating external heat sources.

Perhaps it is a basic mammalian conceit, but we tend to think of temperature in rather large, general terms: "Good morning, it is 62 degrees in Pittsburgh, 96 in Tucson. . . ." In areas much smaller than Pittsburgh, however, there are always many different temperatures because of small local differences in sunshine, wind, precipitation, topography and so on. Many of the heating-cooling mechanisms and behaviors of lizards involve exploiting the varying thermal zones that exist at a given time in their home range—which for some species may be only a few square yards.

The most obvious tactic is to cope with intolerable temperatures on the surface by leaving it—going underground, digging into leaf litter or climbing bushes and trees—to find conditions where the animal can be active or at least can survive. The differences between daytime and nighttime temperatures give further options. Even while on the surface and active, however, lizards are greatly occupied with heat management. Thus an animal will move back and forth between sunny rocks whose temperature is, say, 110 degrees to shady ones of 80 degrees. Or if the air temperature is 60 degrees, it can confine its activities to dark, heat-retentive rocks, which may be 35 degrees or so warmer. In these ways lizards, in effect, extract temperatures from various parts of their habitat and mix them. As a result, a lizard's body temperature may remain constant for several hours, during which time that precise temperature cannot be found in any single spot of the area it is using.

The blending process is abetted by a feature common to many species: the manner in which their skin colors change in response to external heat and light, becoming darker and more heat absorbent in cooler, shadier conditions and lighter and more reflective when it is hotter and brighter. Emerging from burrows to take the morning sun, some iguanids will pale so rapidly that their skins reflect three times more light at the end of a 90-minute period than they did at the beginning of it.

The lizard system for controlling body heat requires some investment of energy—for example, as it scuttles between warm and cool rocks—but it is a small investment compared to that which endotherms (warm-blooded animals) must make to operate their interior

Other topics that Bil Gilbert has written about for SMITHSONIAN *are wildflowers, coatis and groundhogs. His latest book is* On Nature, *a collection of essays.*

Lizards meet the desert's challenge

Baja worm lizard, found only on the peninsula, uses head and forelimbs to work its way through loose soil.

heating and cooling systems. Herpetologist Kenneth Nagy studied the energetics of side-blotched lizards, a species found in open areas of the Sonoran Desert, and found the amount of energy they metabolized, adjusted for weight, to be only one fifty-third of that of jackrabbits inhabiting the same area. The disparity between the energy needs of other desert lizards and birds or mammals is thought to be comparable.

The reverse side of this metabolic coin is that because they use less fuel, so to speak, lizards cannot be so energetic as mammals and birds with greater aerobic (oxygen-consuming) capacities. In short, they lack stamina. But again, in the changeable desert environment strenuous, sustained activity is often less advantageous than patience—waiting for the right moment to take quick action.

Kenneth Nagy has characterized lizards as being remarkable "low-energy machines." To carry this analogy a bit further: somewhat as automobile manufacturers have found many ways to encase the combustion engine to satisfy the demands of disparate users, so evolutionary forces, it is generally assumed, starting with the basic, low-energy lizard machine, have created a wide range of models to satisfy the disparate demands of the Sonoran Desert.

Lizards that "swim" into dunes

Open dune country, such as that found along the lower Colorado in the vicinity of Yuma, is at least in the popular imagination the classic desert environment. An animal very obviously adapted to this kind of habitat is the fringe-toed lizard (opposite). These are 5- to 7-inch-long, flattish creatures with wedge-shaped heads, velvety skins, earflaps, overlapping eyelids and traplike nasal filters that prevent the intake of sand. So equipped, they can "swim" into a dune, giving the impression, says Thomas Wiewandt, the behavioral ecologist-photographer who has spent many hours observing them, of disappearing instantly. Though they spend considerable time underground for security and because of extremely high temperatures, they are daytime hunters of small invertebrates. Their toes are fringed with flexible, outward-pointed scales. These serve them somewhat as splayed paws do a lynx in the deep snow, enabling the lizards to glide quickly and easily over soft dunes.

Though much different in shape and habits, the flat-tailed horned lizard is another resident of the open Sonoran dunes. It is not an agile animal, being a sit-and-wait feeder on insects, particularly ants. Its skin color is closely matched to that of its surroundings, a trait that in addition to being advantageous in terms of heat control serves to camouflage it from predators—large reptiles, desert birds and mammals.

The thorny "horns" (actually specialized scales) that armor its forequarters also have a protective function. There is a record of a western diamondback rattlesnake being killed, its throat punctured by the dagger-like scales of a regal horned lizard (p. 80) it was attempting to swallow. As an additional defensive tactic, some horned lizards squirt blood from their eyes. It is laced with substances repugnant to predators and is ejected as a sinus at the corner of the eye ruptures when the lizard is strongly provoked.

Using heat to escape predators

The desert iguana (p. 87) is often found at the base of dunes where sand is blown into windrows against creosote bushes and other scrub plants. These vegetarians are a foot or more long, including tail, and are perhaps the most heat-tolerant of all vertebrates. They are active and efficient at body temperatures of 105 to 117 degrees. In consequence, the desert iguana can be abroad, foraging in the scrub at times of day that are too hot for potential predators. In a sense, extreme brightness and heat are critical elements of the niche this species occupies.

Rocky outcroppings, slopes and cliffs are a frequently occurring desert habitat that a number of species exploit. Their home ranges are particularly rich in the number of choices provided for temperature control: mixed patches of sun and shade, crevices and ledges, rocks that vary in color and thus in their heat-absorbing and reflecting qualities.

These conditions have created some interesting lizard niches in both place and time. Geckos, for example, make up a large family of nocturnal animals whose members are most abundant in the tropics, where day- and nighttime temperatures are warm and stable. Two gecko species, however, have been able to prosper in the Sonoran Desert. Their nocturnal habits allow them to avoid water loss from the extreme daytime heat, and the rocky areas they inhabit provide heat as well as food, shelter and other vital resources. They are the most vocal lizards, communicating with, or at least identifying each other by, chirps and squeaks as they scurry nimbly about in the dark. All but the most primitive species are equipped with both sharp toenails and adhesive toepads that enable them to run along, upside down, under rock overhangs or, for that matter, on the walls and ceilings of buildings.

Like geckos, many of the rock lizards are small, quick insect hunters, but the collared lizard is a rather large (9- to 13-inch), quick hunter (p. 86) that often preys on other lizards as well as insects. It is a very sure-footed animal, able to jump over and between rocks, often running upright on its two hind legs while using its long tail for balance. So positioned, it somewhat re-

The tail of this chuckwalla is important both as a food reserve and as an indicator of its social rank.

These two whiptails are probably sister clones of one of the species recently discovered to be all female.

The well-camouflaged fringe-toed lizard, also known as a sand swimmer, is adapted to life in the dunes.

A roadrunner feeds a lizard to its chicks. Males often "tidbit"—offer a reptile to a potential mate.

sembles a miniature model of *Tyrannosaurus rex* and stands to small rock dwellers much as that giant carnivore did, it is thought, to lesser reptiles during the reign of the dinosaurs.

To continue in this vein, the common chuckwalla (p. 83) is something of a brontosaurus among lizards of the desert rocklands, being a large (up to 18 inches long), heavy-bodied vegetarian. For three years Kristin Berry studied a population of chuckwallas, marking 116, in a granite outcropping and scree area in the California desert. For about half a year these animals were inactive in underground burrows. In late winter, when surface temperatures began to rise into the 80-degree range, they started to emerge late in the morning. Usually they warmed themselves for several hours, foraged and fed in early afternoon, then basked before retiring to burrows at sundown. Midsummer activity periods were restricted to the morning. When temperatures reached 100 to 105 degrees, they went underground and stayed there.

There is considerable social interaction among chuckwallas that occupy neighboring territories. Aside from courting and mating, much of it is antagonistic and involves males. In Berry's study area, 12 dominant, tyrant males defended relatively large territories against others, mostly by threatening postures and behavior, but sometimes by chasing and fighting with them. Tyrants were usually the largest animals, but there was an interesting exception to this rule. Like that of many lizards, the tail of the chuckwalla is sometimes broken or severed, a useful attribute that no doubt has saved the life of many a lizard, leaving pursuing predators with only a bit of wriggling tail tip. But the tail is an important appendage for lizards, for balancing and often for energy storage. When a portion of it is broken off, most species grow a new one.

Regrown tails are a social disaster

Replacement tails are of a different composition, being supported by a rod of cartilage rather than vertebrae, and often of a different, duller color. Berry found that possessing a regenerated tail had a considerable negative impact on the social status of a male chuckwalla. No matter how large, an animal with a regrown tail did not become a tyrant, and those that had been tyrants ceased to be so if they had lost and then replaced their tails.

Being large animals of exotic appearance and reputation, chuckwallas and Gila monsters have been especially hunted by humans. Today this mainly involves collecting them for the pet or, more accurately, living-curio trade. At times and in places, however, desert residents have fed on them. The Seri Indians, as they traveled on the waters of the Gulf of California, often carried live chuckwallas in their canoes as a source of fresh meat. Some of these may have either escaped or been intentionally released on barren islands. However they came there, some of these islands now support endemic populations of exceptionally large chuckwallas. One of these giant species is sometimes called the piebald chuckwalla, an endangered species found on a single island off Baja.

Howard Lawler, a curator at the Arizona-Sonora Desert Museum near Tucson, has spent considerable time studying the piebalds as part of a project to breed them in captivity. According to him, much of the wild population is found along an arroyo that transects the 26-square-mile island. In midsummer, females congregate, sometimes a dozen in a hundred-square-yard area, in patches of loose sand and gravel where they dig nesting burrows. At the end of the tunnel a female lays 20 to 30 eggs, which hatch in a hundred days or so. After laying, the female leaves and plugs the tunnel behind her which, beyond hiding the eggs, maintains

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A displaying collared lizard lifts his back feet off the hot surface of a rock so he can stay there longer.

suitable conditions of heat and humidity within the nest. During the chuckwalla egg-laying period, females stand guard near the mouth of the burrow. Their objective is to ward off other, still-gravid females who, if they find an unprotected nest tunnel, will often inadvertently reopen it, dig out the eggs already there and replace them with their own. That chuckwallas gather together to lay eggs but then, paradoxically, must guard them against each other seems to be explained by the fact that good nesting soils are in scarce supply in their rocky habitat.

Though there are an estimated 4,500 piebald chuckwallas on their native island, Lawler feels the endangered species status is justified. They breed rather slowly—about a quarter of the mature females lay eggs once every four to five years— and, like all small-island populations, are vulnerable to natural catastrophes. In this case there is a continuing, potential threat of poachers, since one individual may sell for hundreds of dollars on the illegal-animal market. Several chuckwallas were stolen from open enclosures at the Desert Museum and others were killed or mangled, which forced the staff, at least temporarily, to remove the animals from public display.

Though the desert is sometimes thought of as being a uniformly barren expanse, much of it is covered with tough, water-conserving grasses, bushes and small trees. Fringes of the scrub extend into open sand and rocky areas and species of those habitats make some use of it. Others, including the aptly named tree and brush lizards, are especially suited to exploit the vegetation. Whiptails, a New World genus of some 40 species found in deserts and grasslands from the United States to central South America, are typical residents. As the name suggests, the tails are prominent, that of the western whiptail being nearly twice the length of its body, which measures between three and four inches. They are among the speediest of lizards, and when running the tail is carried above the ground and is often lashed back and forth for balance. Like some other scrubland hunters, they dig out their prey—beetles, termites, scorpions, occasionally smaller lizards—from the soil and vegetative litter, locating them by scent.

At the moment, whiptails are the objects of an inordinate amount of scientific attention because, quite recently and surprisingly, it has been discovered that at least 13 species of them are composed only of females that, without being inseminated by males, produce fertile eggs and offspring that are clones of themselves (p. 83). That they or any other vertebrates could reproduce parthenogenetically (without fertilization) was unknown and unsuspected until 1958. In that year a Soviet zoologist, Ilya Darevsky, reported finding all-female species of lizards in Soviet Armenia. Because it was so contrary to conventional biological wisdom, the announcement was initially received with skepticism. Then, in the 1960s, herpetologists, who had never before considered looking for such things, began finding unisex species of whiptails in the western United States. Thereafter, working with captive breeding populations, Charles Cole and Carol Townsend of the American Museum of Natural History determined that generations of these animals had reproduced themselves parthenogenetically.

The existence of parthenogenetic vertebrates such as the whiptails has been accepted as incontestable only during the past decade. Understandably, behaviorists, geneticists and evolutionary zoologists currently have many more questions than answers regarding the implications of this phenomenon. In the most general terms, however, life without sex is another response to the basic preoccupation of all species: dealing effectively with their physical and social environment. In this sense it is comparable to sand swimming, squirting blood from the eyes or regenerating tails.

The evolutionary process—making, maintaining and changing niches, altering forms and behavior—can be called competitive. But figuratively it is much more like an ongoing self-help or improvement exercise than a sporting contest. Blessedly there seem to be no scoring systems that certify cloned whiptails—or any of the rest of us—as winners or losers.

Flowers, buds and fruit of the creosote bush are a staple food for the desert iguana, a strict vegetarian.

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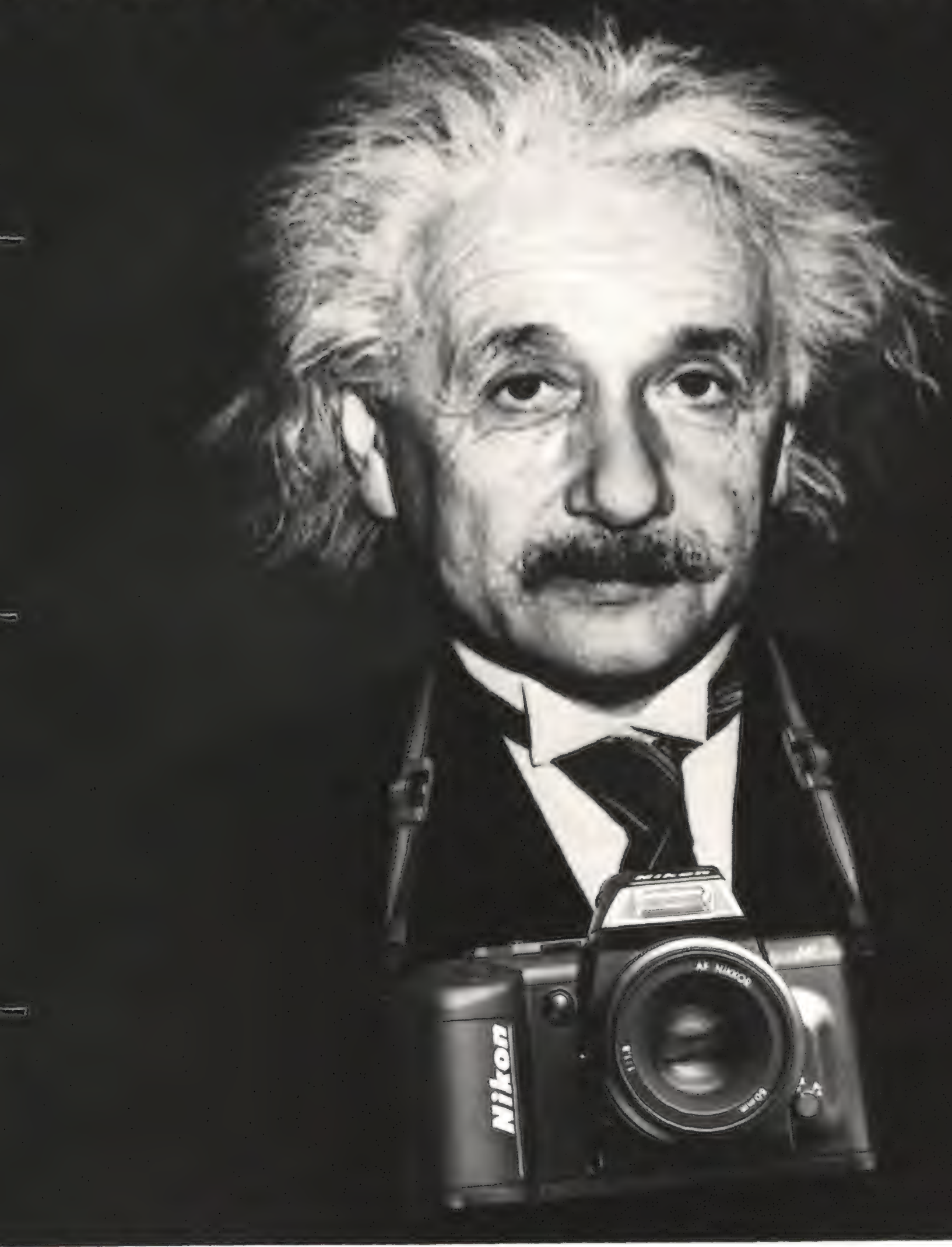

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By John P. Wiley jr.

After five centuries, a devoted modeler gives shape to genius

For 50 years, this master craftsman has added three-dimensional reality to the dreams of Leonardo da Vinci; most work just fine

In Lower Manhattan workshop, Roberto Guatelli is crowded by models made from Leonardo's sketches.

For more than half a century, an engineer from Milan has been bringing to life in red oak, walnut, brass and bronze the sketched imaginings of a countryman he calls the Universal Genius, Leonardo da Vinci. Working from the notebooks of the Florentine artist, Roberto A. Guatelli has demonstrated that many of the master's ideas were indeed practical. Starting in 1951, International Business Machines (IBM) has shown Guatelli's models, such as those on these pages, paired with the original drawings, in traveling exhibits.

Leonardo was unquestionably a genius. He worked as a sculptor, painter, musician, architect, anatomist, hydrologist and weapons designer, and through all the years kept notebooks, written in mirror script and crowded with sketches for his ideas on everything from tanks and machine guns to how humans could fly. His backward writing was not an attempt at secrecy; anyone with a mirror can read it. Guatelli says the master was ambidextrous, that he sketched with his right hand while he wrote with his left—simultaneously. Guatelli argues that Leonardo had to save any time he could: "If you worked eight hours a day, six days a week just copying the sketches, it would take you 60 years to finish."

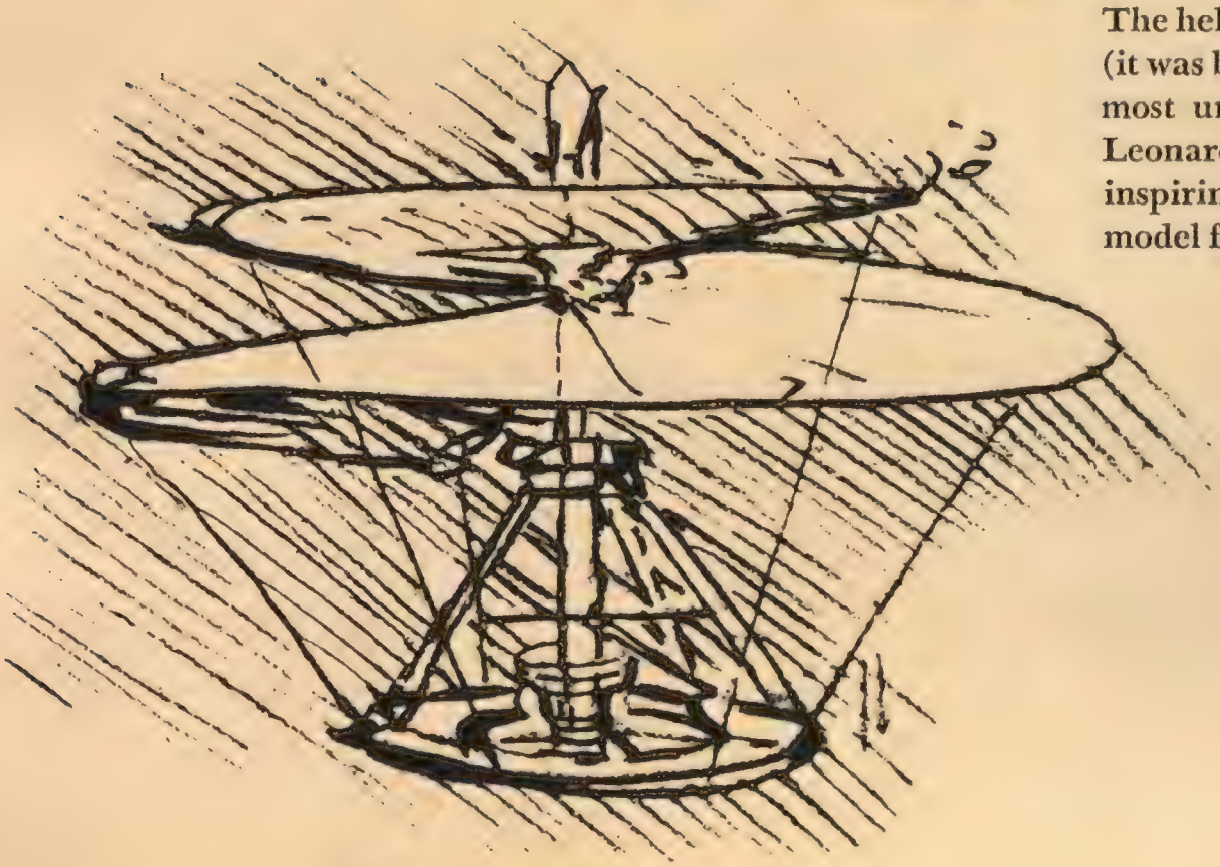
Historians know that when Leonardo died in 1519, the notebooks totaled many thousands of pages. Over the years, some were lost and others stolen, then sold and resold, occasionally being cut up in the process. Some simply disappeared, but others have mysteriously reappeared. In about 1762 Robert Dalton, George III's librarian, opened a forgotten chest in Kensington Palace and found a treasure trove of drawings and studies.

Roberto Guatelli wrote his doctoral dissertation on Leonardo and has devoted his life to the man of Vinci. In the late 1930s Benito Mussolini asked the young scholar to put together an exhibit on the Genius; he produced 156 models for a show that opened in 1939. The next year the show moved to New York and then —before Pearl Harbor—to Japan. Later, when Italy surrendered to the Allies, Guatelli refused to swear allegiance to Japan. He spent 22 months in a concentration camp, but his plight was eased by 600 cigarettes a month arranged by the Emperor's brother, who had seen the exhibit in Tokyo. The original models were destroyed in bombing raids.

Back in the United States after the war, Guatelli built another 56 models for an exhibit that opened in Los Angeles in 1950. The show was a great success and went on to tour the country. In 1951 IBM hired Guatelli to continue making the models. Ten years later he left the company and opened his own shop in New York to keep on doing exactly what he had been doing: making models of Leonardo's inventions.

At present, one large collection of Guatelli's Leonardo models is in Japan and six smaller ones are touring the United States under the auspices of IBM. How does Guatelli feel about the man whose work he has been re-creating for so long? "I feel like he is my dead grandfather." He adds, "And now I am safe. If he were here, he would chase me around the block, yelling 'What are you doing to my work?' "

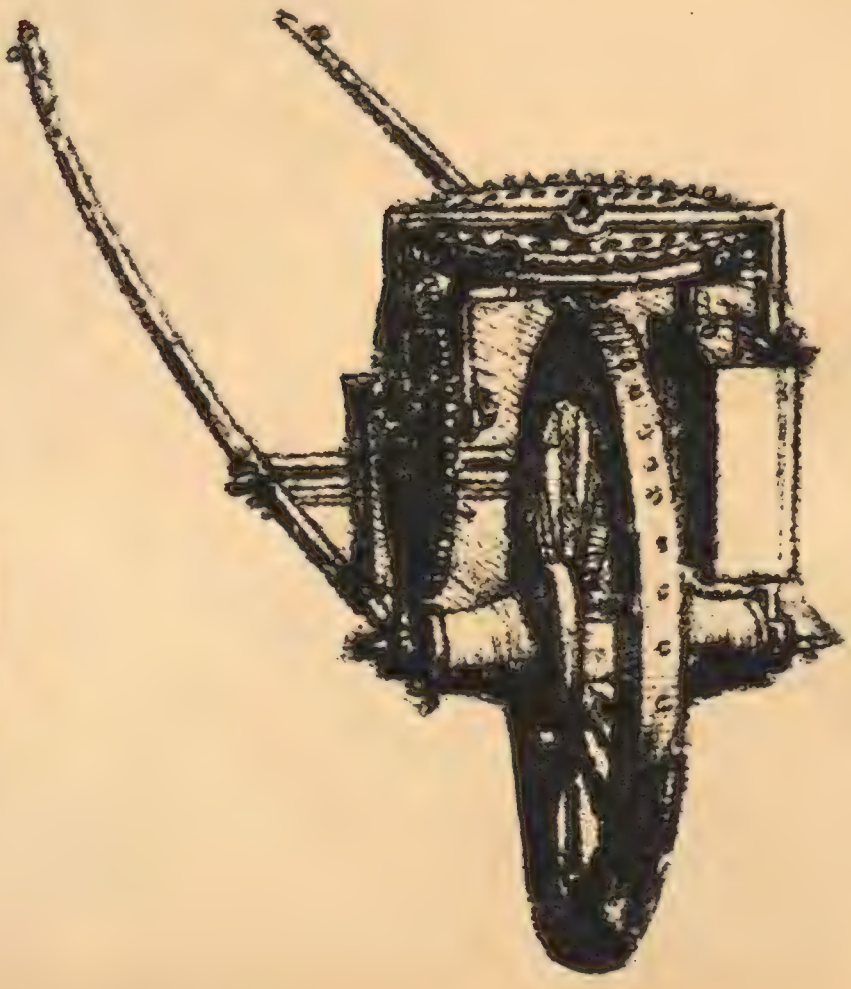
Photographs by Lee Balterman and Charles H. Phillips



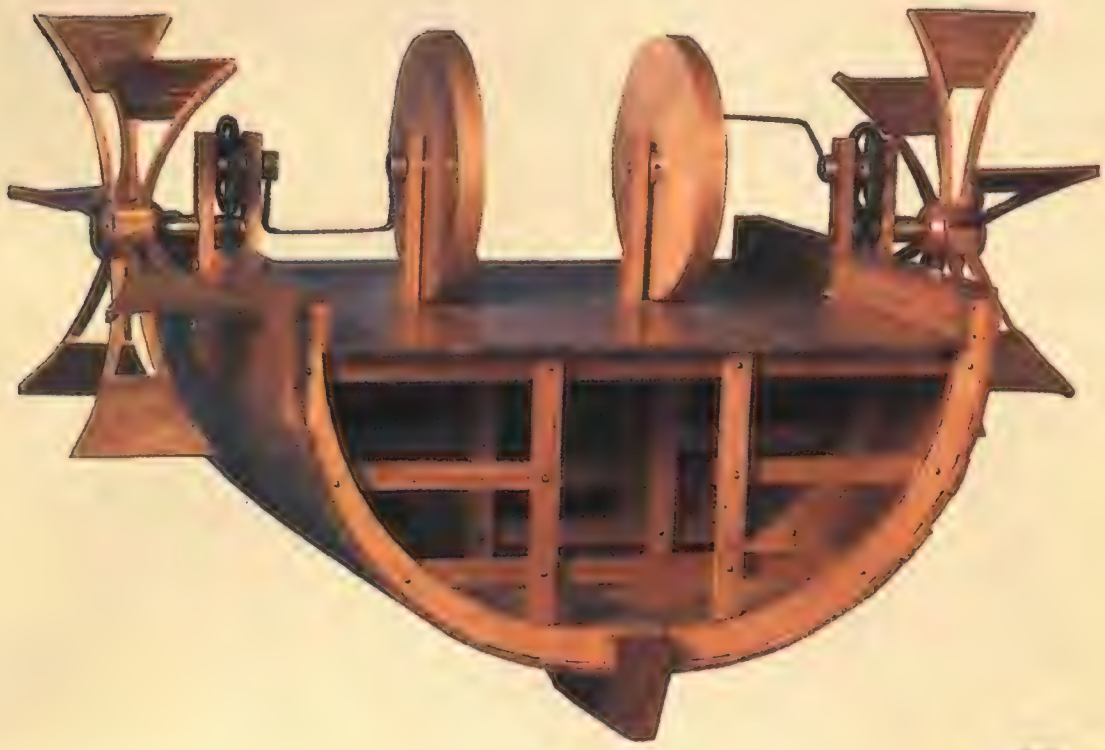
The helical helicopter was not an original idea (it was based on a popular toy) nor would it, most uncharacteristically, have worked. But Leonardo's drawing has been credited with inspiring Igor Sikorsky. Guatelli fashioned the model from the Leonardo sketch shown at left.

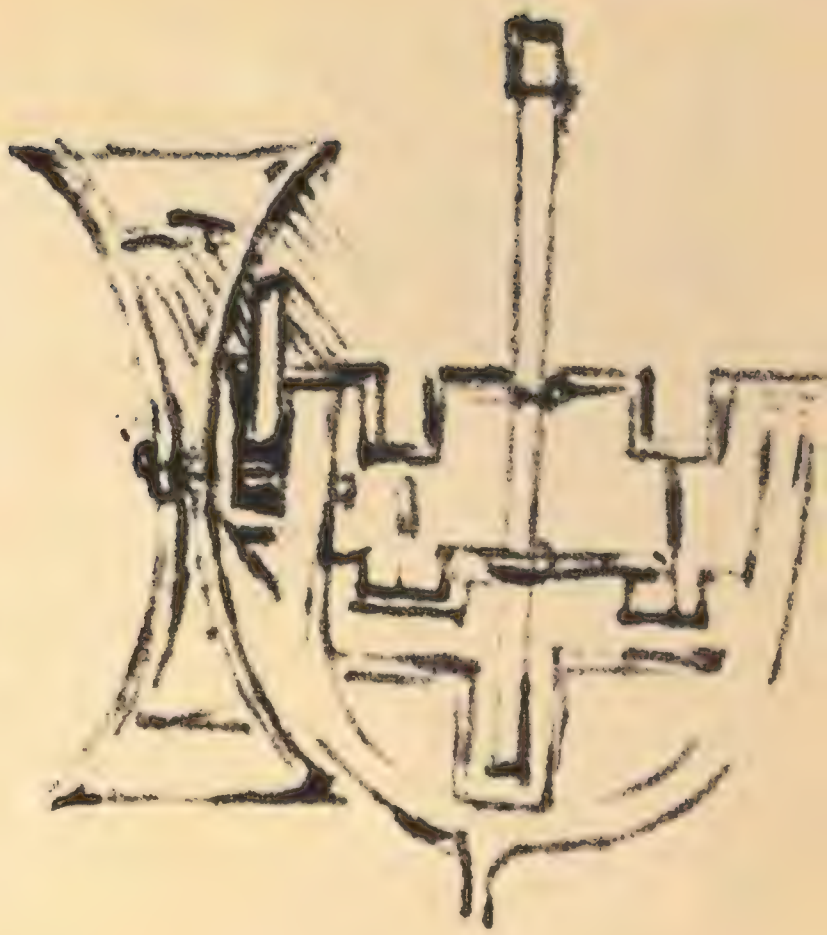
Leonardo experimented for years with moving-wing aircraft called ornithopters, unaware that humans are not strong enough to flap wings large enough to lift them. Pilot used both arms and legs for power.

A mapmaker, Leonardo invented a series of odometers to measure distance. In this one, arm on axle moved the vertical gear wheel. That turned horizontal wheel, dropping pellets in box. Pellet count gave distance.

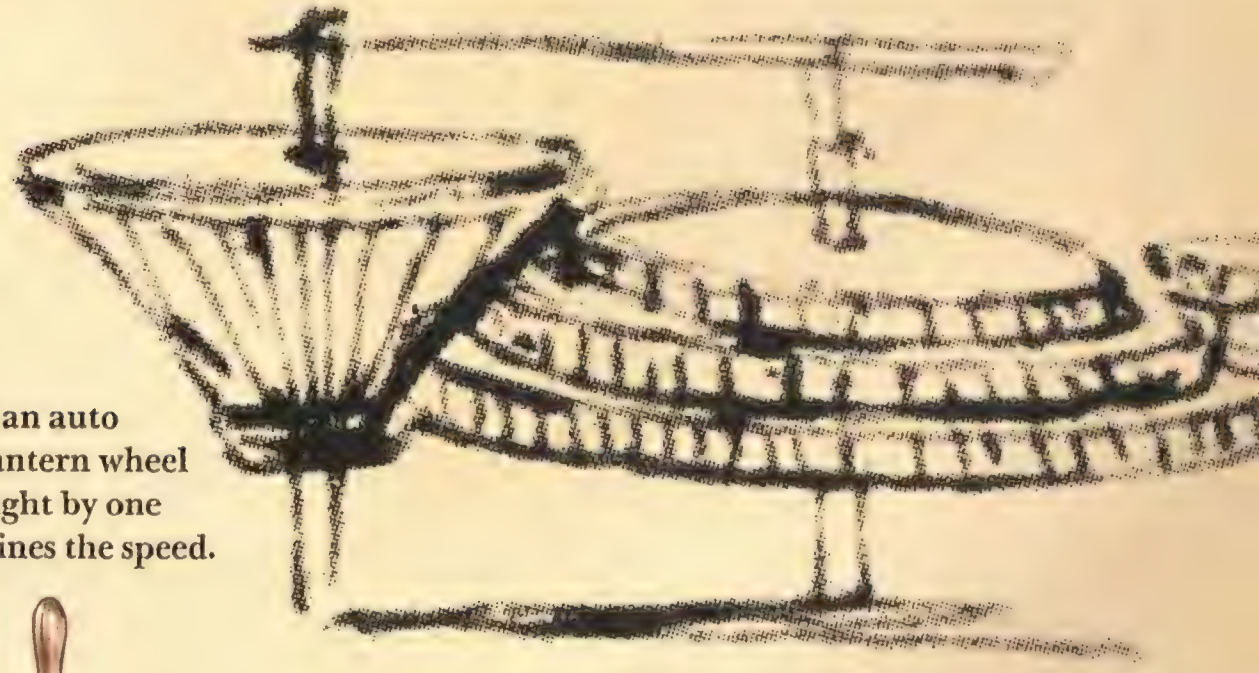


A paddle boat was an improvement on the ideas of the time. Flywheels near centerline helped keep wheels turning; gears turned the paddles at high speed. Centuries later, steam power made the plan practical.



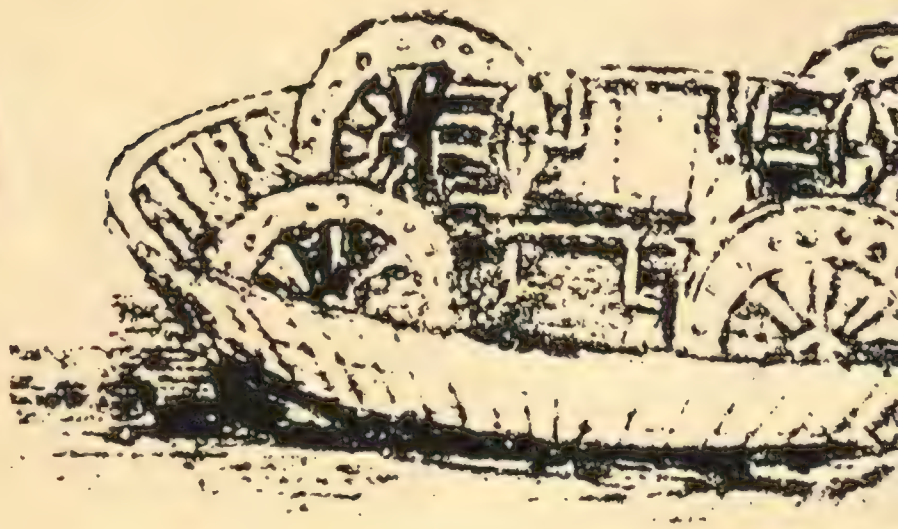


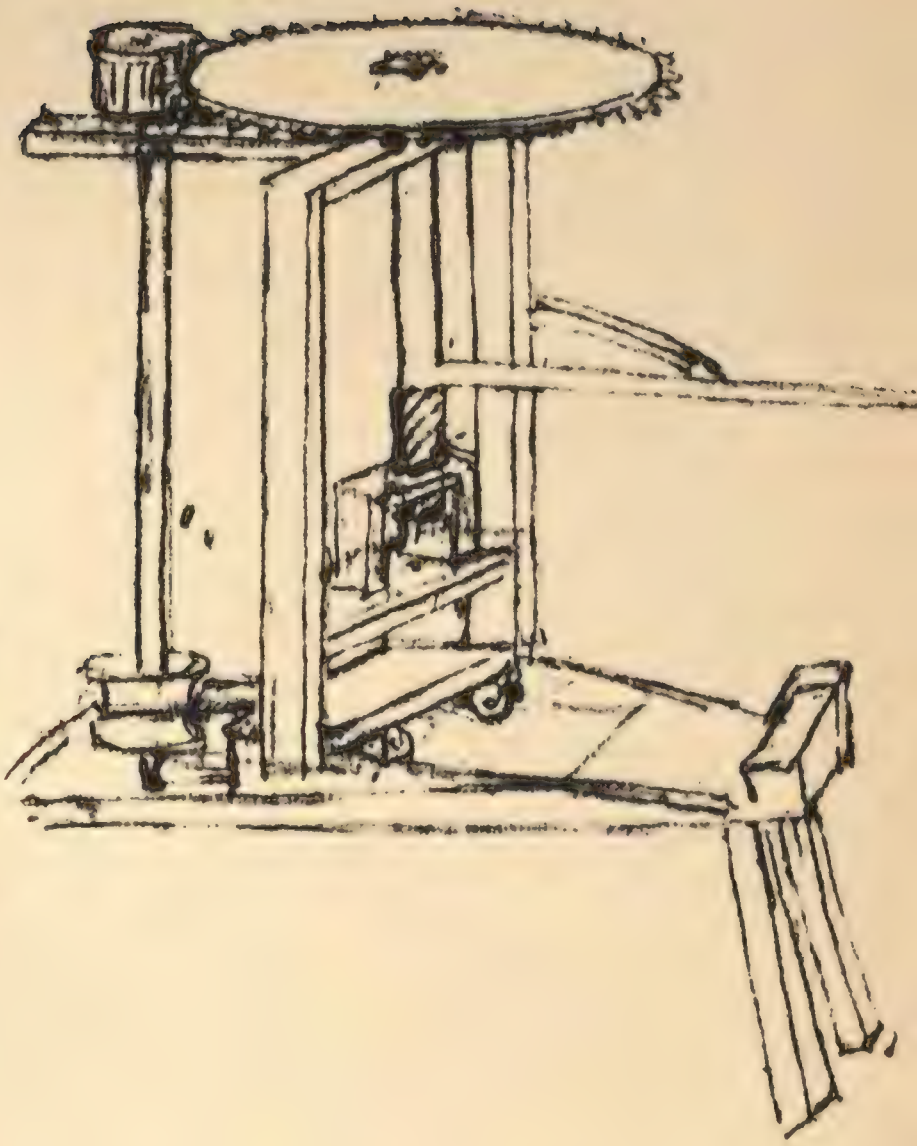
A transmission system much like that of an auto employed three gears. Power from the lantern wheel at the left is transferred to the shaft at right by one of three wheels. Choice of wheel determines the speed.



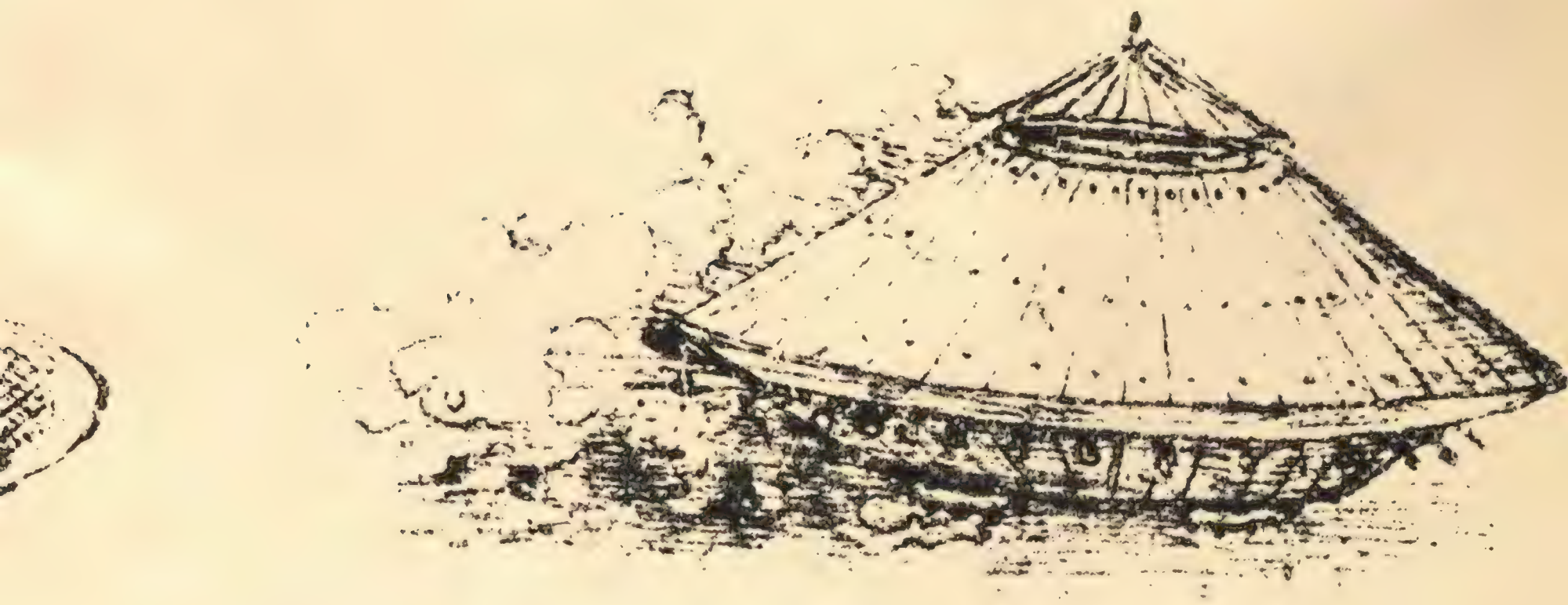
Leonardo's plan for a parachute remained unknown until the late 1800s, not quite a century after the first air-to-ground jump was made. Pole in the sketch added stability.

Leonardo improved upon ideas of his day for armored vehicles—what we would call tanks. Men could push this one into enemy ranks as its cannons blazed. Infantrymen would follow the tanks, as they do today.





Only about half a century after Gutenberg invented his type, Leonardo had worked out practical improvements for the presses. None of his own work was printed, however, until 132 years after his death.



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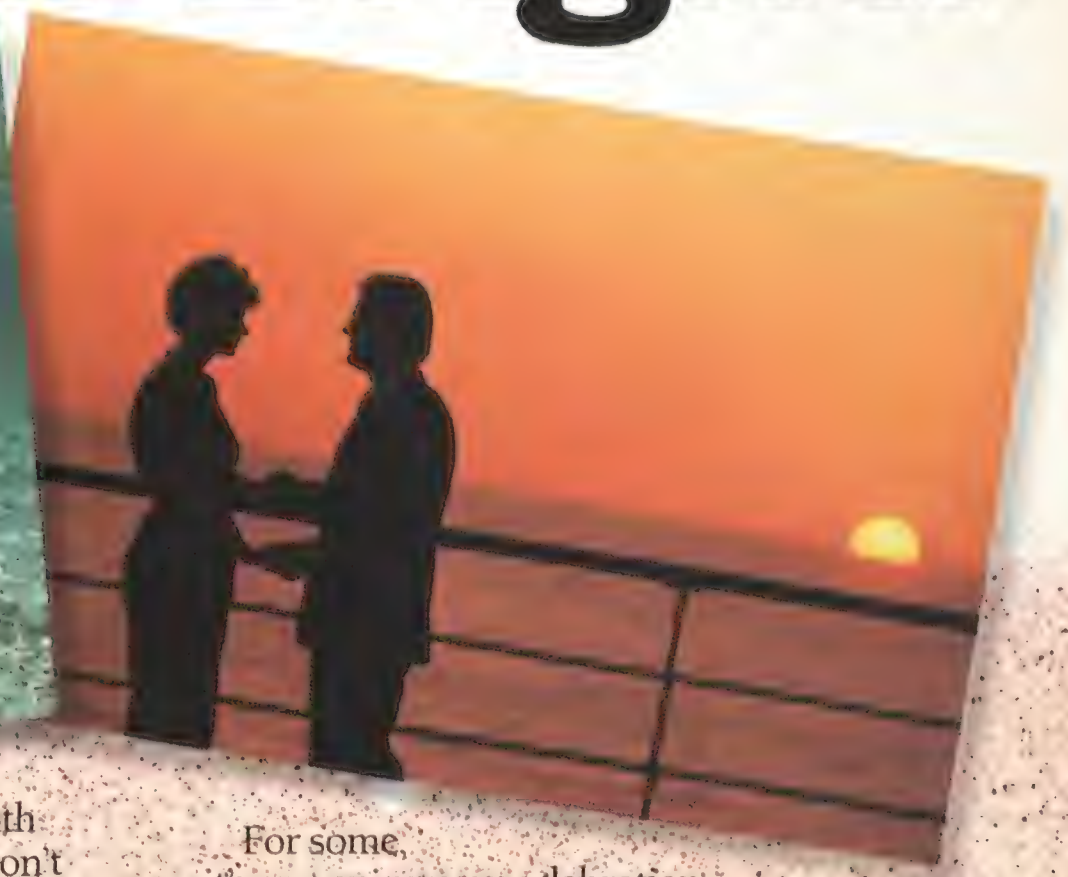

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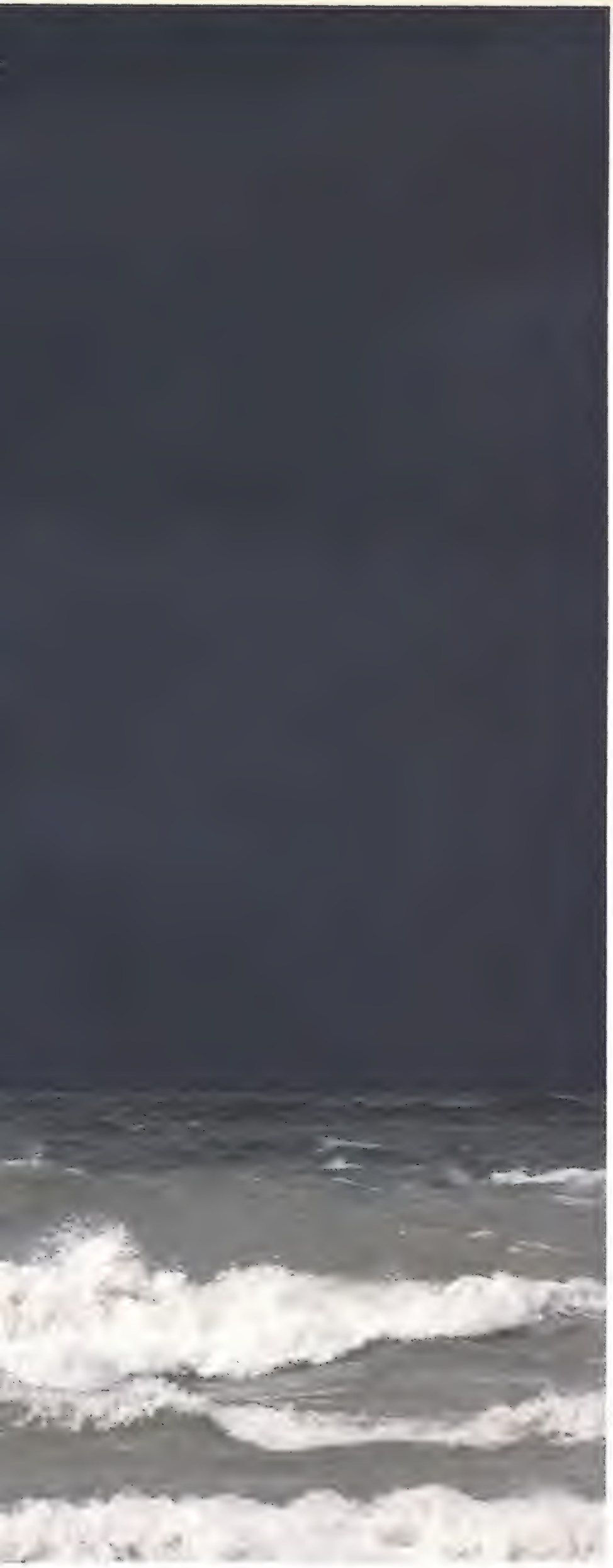


By Dennis Hanson

The tide is turning for old beacons adrift at land's end

Threatened by weather and suffering from neglect, dozens of lighthouses are being fixed up and recycled as museums and hotels

Welcome to the San Francisco Country Fair. You're just in time for the wackiest event of the day—the fog-calling contest. Those funny-looking people making a lot of noise over there are the contestants. The idea is to see who can do the best imitation of a foghorn. The winner is to be chosen on the basis of accuracy, resonance, staying power and costume.

Wayne Wheeler is the master of ceremonies. He is also a U.S. Coast Guard employee, founder and president of the U.S. Lighthouse Society and the impresario of this annual contest. "One year we had a man somersault onto the stage with white cotton balls hanging all over his body," Wheeler says. "He was supposed to be the fog rolling in. Another contestant came wearing a lot of Indian feathers. He was Apache fog—a *patchy* fog, get it? We've had a man masquerading as a lighthouse. He had on a helmet with a lantern and a little wire sticking out to the side with a plastic seagull flopping around on the end of it. We had a woman dressed up as the Golden Gate Bridge. One guy brought a fake-brick prop that looked like the wall of a bank complete with a model of an automatic teller machine. Behind the wall he had these huge metal tanks with long tubes. He dropped his bank-card into the teller machine and that activated a

Rough water and dark clouds menace the St. Joseph North Pier lights on southwestern shore of Michigan.

Workers attend to restoration of New York's historic Fire Island Light, paid for by private contributions.

mechanism that sent steam billowing out of the tubes. He was supposed to be a fog bank. When we started doing this five years ago I was amazed to see a crowd of 2,500 show up. Now we get as many as four or five thousand spectators standing around."

There is method to this madness. Most people associate fog and foghorns with lighthouses, and promoting the cause of lighthouse preservation is what Wheeler's San Francisco-based organization is all about. In addition to sponsoring the fog-calling frolic, it publishes a quarterly magazine, sells T-shirts and bumper stickers, runs a photography contest, maintains a library and photography archive, and serves as an international clearinghouse. Although it is only three years old, the Society already has more than 3,500 members representing all 50 states and 10 foreign countries. Wheeler is hoping to reach the 20,000 mark by 1989. "There's just a tremendous amount of interest out there," he says.

That's understandable. The lighthouse is, after all, one of the most conspicuous and familiar fixtures on the American landscape. At one time more than 1,400 of these picturesque structures served as navigational aids along the nation's 90,000 miles of coastline, riverbanks and lakeshores. Today about 750 are still standing, but perhaps only 400 of these are operational. Most of the others have, in effect, been abandoned to the elements. Neglect, vandalism, weather and erosion are taking a heavy toll. Yet even as the deterioration becomes ever more worrisome, lighthouse rescue efforts are getting under way all across the country.

Wheeler's group is not the only one stirring things up. The National Trust for Historic Preservation has doled out more than $300,000 in grants to lighthouse-restoration projects. The Lighthouse Preservation Society, headquartered in Rockport, Massachusetts, has been drumming up support for such work in New York and New England. The Great Lakes Lighthouse Keepers Association in Southfield, Michigan, has been renovating several structures, including the St. Helena Light in the Straits of Mackinac. But the real action is taking place at the grass roots level.

Saved from the wrecker's ball

Appalled at the prospects of losing their beloved local landmarks, dozens of communities, organizations and entrepreneurs have "adopted" lighthouses and mobilized work crews to fix them up before they fall down. More than 100 buildings have been saved in the past five or six years. Some have been meticulously restored to their original condition and are being maintained now as museums. Others have been transformed into hostels, bed-and-breakfast inns, luxury hotels and other self-supporting enterprises.

Boston Light on Little Brewster Island occupies the site of the United States' first lighthouse, which was destroyed by the British in 1776. In two years, it will become last Coast Guard lighthouse to be automated.

The story of how one aroused citizenry saved a crumbling structure on the south shore of New York's Long Island provides a fairly typical example of what is going on. Built in 1857, the black-and-white banded Fire Island Light was decommissioned by the U.S. Coast Guard in the 1970s and five years ago it was transferred to the National Park Service, which runs the Fire Island National Seashore. When the Park Service was unable to dig up enough money to restore the facility, a number of influential residents in and near the town of Bay Shore spearheaded the formation of the Fire Island Lighthouse Preservation Society. Within four years, the group raised more than $1 million from several thousand contributors.

The society sponsored fund-raising concerts, fashion shows, five-mile runs, clambakes, black-tie dinners. One cocktail party netted $13,000. Liz Claiborne, the fashion designer, drummed up some substantial corporate donations. A group of youngsters collected aluminum cans on the beach and sent a check for $186.

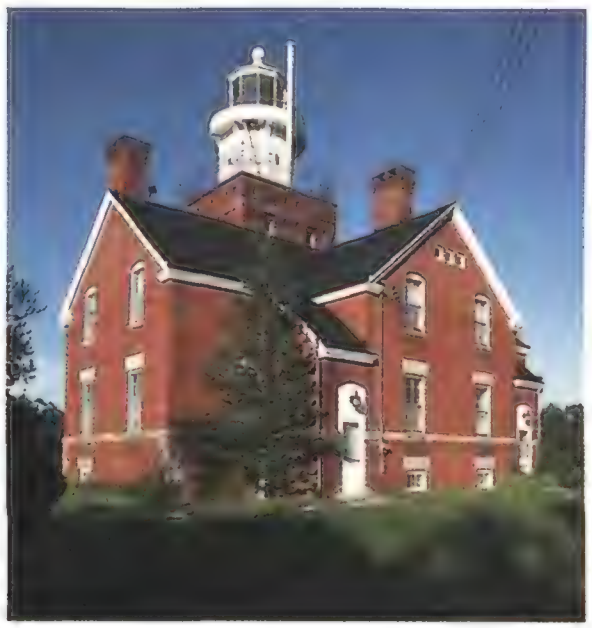
The money was used to refurbish the lighthouse and turn the keeper's quarters into a public information center with various historical and environmental exhibits. On May 25, 1986, some 600 boats turned out on Great South Bay to celebrate the relighting of the tower. "It was an emotional moment," says Suzanne Schaper, who serves as the administrator of the society and who grew up in the Fire Island area. "You saw tears everywhere."

Clearly there is something special about lighthouses that goes far beyond their utilitarian purpose. They are perceived as monuments to the country's maritime past, symbols of Man's stormy relationship with the sea, beacons of hope and homecoming. They stand for integrity and reliability. The resourceful lighthouse keeper, who endured the tedium, danger and deprivations of his job with heroic stoicism, has become part of our national folklore. And of course the dramatic tower standing at land's end is an indispensable element in our popular image of how a shoreline should look. "People have different opinions about everything," Wayne Wheeler says, "but I never met anyone who hated a lighthouse."

The earliest forerunners of lighthouses were beacon fires kindled on headlands and capes to guide fishermen home and warn mariners off dangerous shores. The first man-made tower may well have been the spectacular Pharos of Alexandria, one of the Seven Wonders of the Ancient World. Erected by the Egyptians in the third century B.C., it was 450 feet high (the

Cape Hatteras tower in North Carolina is the tallest brick light.

Building at Big Bay Point on Lake Superior operates now as an inn.



The Point Pinos, California, station is a model of maritime symmetry.

Cape Elizabeth Light on Maine coast resembles a New England home.

Holland Harbor Light in Michigan is referred to locally as Big Red.

Walkway across beach at Nantucket leads to the Brant Point beacon.

Solar energy helps power lighthouse in Apostle Islands of Wisconsin.

Statue of Liberty is 305 feet) and its wood-fueled flames could be seen for 35 miles in clear weather. The mighty Pharos stood watch over the Mediterranean for 15 centuries before it was finally toppled by an earthquake.

The seafaring Phoenicians put up numerous lighthouses, and some of the oldest towers in eastern Europe were erected by the Romans. One of the most elegant lighthouses of all time, the Cordouan light, was designed and built in the late 16th and early 17th centuries by the architect-engineer Louis de Foix on an island in the midst of the Gironde estuary near Bordeaux, France. It took 27 years to complete, rose 200 feet into the sky and featured, among other things, vaulted ceilings, arched windows, pillars, parapets and a complement of royal apartments furnished with murals, statuary and other grand appointments. After undergoing extensive renovations over the centuries, the Cordouan light is no longer quite so luxurious but it is still in operation.

The first navigational lights in the New World were probably lanterns hung at harbor entrances. The first lighthouse was put up by the Massachusetts Bay Colony in 1716 on Little Brewster Island at the entrance to Boston Harbor. Paid for and maintained by "light dues" levied on ships, the original beacon was blown up by the British in 1776. By then, there were only a dozen or so true lighthouses in the Colonies. Little over a century later, there were 700 lighthouses in the Americas, more than 5,000 worldwide.

It is not quite true that no two lighthouses are alike. The first eight erected on the West Coast in the 1850s, and a number of others constructed there after that, featured the same basic New England design: a Cape Cod dwelling with the tower rising from the center, or standing close by. In New England and elsewhere, though, lighthouses reflected a variety of architectural styles, from Victorian to Second Empire. Since most stations in the Northeast were built on rocky eminences and therefore had the advantage of height to begin with, enormous towers were not the rule. Some were made of stone and brick; others of wood or metal. Some stood on pilings or stilts; some were fastened to rock with iron rods. Still others, anchored to granite foundations or caisson-based structures in the middle of harbors and bays, appeared literally to ride the waves. Farther south, from Maryland through the Florida Keys, the coast was low and sandy. It was often necessary to build tall towers there —massive structures like the majestic Cape Hatteras, North Carolina, lighthouse, which was lit in 1870. At 190 feet, it is the tallest brick lighthouse in the country; it is also seriously threatened by erosion.

Notwithstanding differences in appearance and construction, most American lighthouses shared several features: a light, living quarters and sometimes a bell (or, later, a foghorn). They also had something else in common: a keeper and, usually, his family. The keeper's essential task was trimming the lantern wick in order to maintain a steady, bright flame. The earliest keepers come from every walk of life—they were seamen, farmers, mechanics, rough mill hands—and appointments were often handed out by local customs commissioners as political plums. After the administration of lighthouses was taken over in 1852 by the U.S. Lighthouse Board, an agency of the Treasury Department, the keeper corps gradually became highly professional. A standardized series of instructions and uniforms, and a notoriously tough inspection program, were introduced. One member of the new Lighthouse Board was Joseph Henry, the first Secretary of the Smithsonian Institution.

Battling boredom and bad weather

It is tempting to romanticize the tranquillity and isolation of the lighthouse keeper's life, but sometimes it was true hardship duty. Many keepers and their families fought a constant battle with loneliness, boredom and bad weather. At the same time, most took fierce pride in their independence and considered it a sign of weakness to ask for help from the "mainland." They grew their own vegetables (soil conditions permitting); caught fish, lobsters, crabs; captured rain water in cisterns, and sometimes kept a cow for milk. They were responsible for maintenance and repair work and they saw to the cleaning and polishing of their lanterns and brasswork with a zeal that was nothing less than astonishing.

On light stations that were exposed to the full brunt of storms, the work was sometimes downright harrowing. During one ferocious blow in 1882, the keeper of the Tillamook Rock Lighthouse off the coast of Oregon looked on in horror as waves pummelled the top of his tower, which loomed fully 133 feet above sea level. Some keepers were washed right off their islands or died when their lighthouses were destroyed by wind and waves; others perished trying to rescue seamen in distress.

When the keeper was away or indisposed, his wife was expected to fill in for him. She usually was able to do so, as an 1873 entry in the keeper's log at the Egg Rock, Maine, lighthouse makes clear: "A severe rainstorm. Keeper went ashore to get some groceries and got caught in the storm; was detained away four days on account of the rough seas. The wife kept the light

Free-lance writer Dennis Hanson, formerly an editor at Audubon *magazine, resides outside Bend, Oregon, not far from the Cascade Mountains.*

Ice encrusts Lake Michigan light after wind-tossed waves broke over the facility during midwinter storm.

all trimmed and burning bright and clear. Keeper was drunk ashore all the time."

From the very beginning, lighthouse technology and operations evolved steadily in response to the demand for better illumination and greater operating efficiency. The original whale-oil lamp was eventually replaced by the kerosene lantern. This in turn gave way to the electric light bulb. The early reflectors and magnifiers were rendered obsolete by the elaborate Fresnel lens, a beehive-shaped system of precision-ground prisms that refracts and magnifies a modest light source into an intense beam. After the Lighthouse Service was absorbed by the Coast Guard nearly 50 years ago, the keepers were replaced by Coast Guardsmen, who are themselves being succeeded by automated light and signal systems and electronic fog detectors. Only a handful of manned lighthouses remain in operation today and the last of these, the venerable Boston Harbor Light, is scheduled to be automated by 1989.

Frank Schubert, the country's last civilian keeper, joined the old Lighthouse Service in 1939 as a buoy tender. He worked at a number of lighthouses before taking over the Coney Island Light in the Seagate section of Brooklyn, New York. Today, 26 years later, he is still there. Schubert and his wife, Gladys, raised two of their three children at the station and, although he hasn't had a vacation in 30 years, he has no regrets. "Listen, I'll tell you the truth," he says, "it's been a wonderful life." Coney Island is due to be automated soon but Schubert hopes the Coast Guard will let him stay on after that. "If they just seal the place up and leave," he explains, "vandals will have it stripped clean in a month."

The high cost of preservation

Decommissioning some lighthouses and automating others has doubtless saved taxpayers a lot of money. The flip side of this is also plain to see. Maintenance is neglected and too many lighthouses are showing signs of serious decay. In recent years the Coast Guard has leased several dozen stations to states, communities and nonprofit groups with the proviso that the lessees are responsible for upkeep. Maintaining the old structures is expensive, however, and local groups can't always afford it. The Coast Guard and the U.S. Lighthouse Society are leery of commercialization but the Lighthouse Preservation Society and other interested parties argue that subletting of lighthouses by profit-making groups is one practical preservation alternative. "Converting lighthouses into inns, restaurants and other revenue-generating enterprises can be done without compromising their historical integrity," says Valerie Nelson, the executive director of the Light-

Guests toast before meal at the East Brothers Island Light, San Francisco Bay, operated as inn since 1980.

While East Brothers patrons enjoy view, keepers Leigh and Linda Hurley relax with their daughter Yquem.

house Preservation Society. "And the profits can be used to help keep the buildings in good shape and open to the public."

But there is a limit to the number of lighthouses recycling can save. Along parts of the Maine coast, for instance, lights are located every few miles. Without a significant infusion of federal money, it seems quite likely that many of them will fall into a state of hopeless disrepair. A measure to establish a national trust fund for lighthouse preservation was introduced in Congress this year. Until it or similar legislation is passed, the best and only hope for many structures lies with private initiatives.

Take the 92-year-old Big Bay Point Lighthouse on the shore of Lake Superior in Upper Michigan. It is owned and operated as a bed-and-breakfast inn by Norman (Buck) Gotschall, a onetime schoolteacher and real estate broker. Back in 1966, the Coast Guard sold the station to Dr. Albert Pick, a plastic surgeon who specialized in noses. The doctor did some remodeling, installed several bathrooms and furnished the place with antiques. The next owner added more bathrooms and now Gotschall is renting out six guest rooms, which altogether accommodate 14 people, at $35 a person per night. He specializes in small groups and conferences.

Recent guests have included cross-country skiing and hiking parties, a group of artists, a local history symposium and a family celebrating a college graduation. Gotschall also sees quite a few "lighthouse detectives" who want to inspect his 1,500-pound Fresnel lens, which he will assemble soon for display. The innkeeper goes shopping once a week for provisions; otherwise the solitude suits him just fine. "The fishing's real good around here," he says.

Whereas Gotschall is in business to make money, Leigh and Linda Hurley run the East Brothers Island Lighthouse in San Francisco Bay as a nonprofit inn. The Coast Guard was planning to tear down the light in 1979. Instead it ended up leasing the facility to a group of preservationists led by Walter Fanning. A retired businessman, Fanning is the grandson of a man who was a keeper of the lighthouse and he currently serves as vice president of the U.S. Lighthouse Society. After extensive restoration work, the lighthouse opened as a luxury inn in 1980. The Hurleys are employees of the nonprofit group that leases the lighthouse and all revenues are used for maintenance and operation. "We're generating enough money to stay out of the red," says Leigh Hurley.

The lighthouse has four guest rooms and charges $250 a night per couple. That includes breakfast, champagne, a gourmet dinner, lodging and transportation across the bay. The main appeal of the inn is its romantic isolation. "Most of our guests are celebrating a birthday or anniversary," says Linda Hurley. "They want to get away from everything and after they spend a night here they feel like they've been gone a week." There's only one problem. Sometimes the seas are so rough guests can't make the crossing.

If the East Brothers inn caters to a fairly limited clientele, the three lighthouses currently being leased by American Youth Hostels Inc. (AYH) take an altogether different tack. Pigeon Point, north of Santa Cruz, California, accommodates up to 50 guests a night and serves 15,000 people a year, including sev-

New lives for old lighthouses

Frank Schubert, the last civilian lighthouse keeper, has spent 26 years at New York's Coney Island Light.

eral thousand who tour the lighthouse on weekends. Point Montara near Half Moon Bay, California, accommodates 35 people a night and Tibbetts Point on the New York shore of Lake Ontario can handle 9. "I don't like the idea of using historical resources for a limited, exclusive population," says Nina Janopaul, AYH's development director. "We emphasize access."

It costs only $6 a night to stay at one of the hostels and there haven't been many empty beds. "Most of our hostels get good business for two or three years and then hit a plateau," Janopaul says. "With these lighthouses, business keeps increasing every year." That's why the organization wants to expand its lighthouse program. Currently it is studying 30 additional possibilities, including several on the Gulf Coast and the Great Lakes.

The Coast Guard still operates lights and radio signals at all three AYH facilities, and when the idea of turning them into hostels came up in the late 1970s the service was worried about vandalism. Eventually it agreed to transfer the structures to the California Department of Parks and Recreation, which then leased them to AYH. The Parks Department spent $400,000 on restoration work at the two California lights and AYH chipped in $100,000. Both stations were badly run down—windows broken, plumbing ripped out, fences torn down, walls sprayed with graffiti. "It was a joy bringing them back to their glory," Janopaul says.

A record of life on the Hudson

At one time five lighthouses guided barges, fishing boats and cruise ships up and down the Hudson River. One of them, the Kingston-Rondout Light, was built in 1912 and decommissioned in 1954. Three years ago a museum based in Kingston, the Hudson River Maritime Center, leased the light from the Coast Guard. Since then the center and the city, represented mainly by public works supervisor Jay Hogan, have worked together to repair and restore the structure, which stands on a deteriorating jetty at the junction of Rondout Creek and the river. Eventually the lighthouse will serve as a branch of the center, featuring displays of lenses, lanterns, tools and other artifacts from Hudson River lighthouses. The living quarters will be re-created; photographs, scrapbooks and survivors' journals will document what life was like for the keepers and their families.

Even without exhibits in place, the lighthouse has attracted 10,000 visitors over the past two years. The public has access to the tower and many people reach it by excursion boat in order to enjoy a spectacular view of the Hudson. "This river's lighthouses are a lot more than brick and mortar," says Marita Lopez-Mena, who is the executive director of the center.

A man sets out to discover the origins of human time. To define mankind's presence in history.

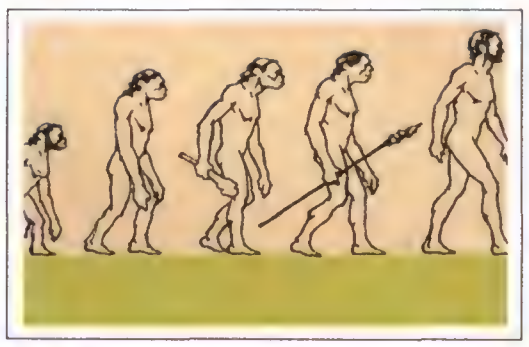
An epic challenge. But one well-met by Richard Leakey. Definitive paleoanthropologist. Director of Kenya's National Museums. Author of the much acclaimed *Origins* and *The Making of Mankind.*

Some men merely make history. Mr. Leakey re-defines it.

His heralded finds at Lake Turkana in Kenya altered many previously unchallenged anthropological views.

Asia had been identified as the birthplace of modern humanity. Leakey unearthed evidence establishing Africa as its origin.

Richard Leakey and Rolex: linked by a reverence for the majesty of time.



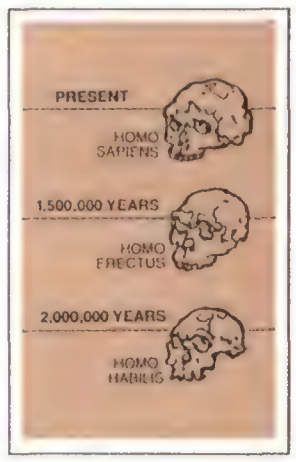
From Kenyapithecus to Homo sapiens, a 14,000,000-year walk through time.

Human evolution was commonly considered an unbroken cord. His discoveries confirm more complex lines of descent.

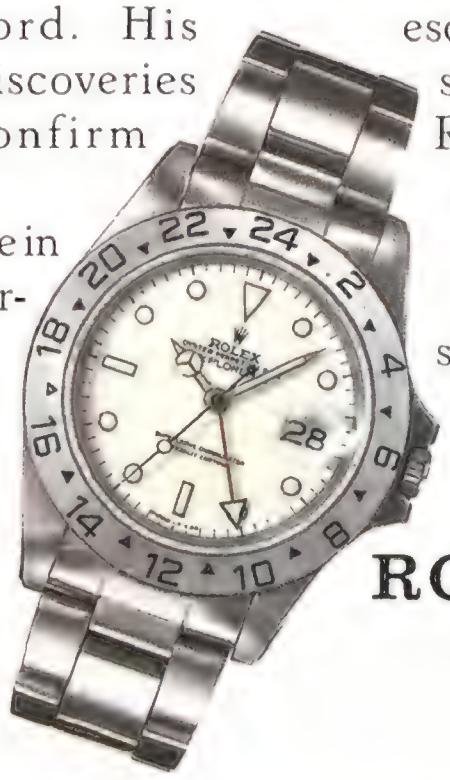
Many focus on the violence in our species. He sees us as inherently cooperative, stressing our forebears made tools, not weapons.

This piecing together of the evolutionary mosaic demands much of the scientist. And no less of his Rolex.

Whether foraging for fossils in desert scrub, or scrambling over rocky escarpments in search of them. Richard Leakey and his Rolex. The pairing is ordained by a shared vocation —the comprehension of time in the fullness of its majesty.



Leakey's outline of human evolution.



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"They symbolize a very different way of life than the one we know. They're almost like churches—singular, standing above it all."

Ken Black is the director of Shore Village, a maritime museum in Rockland, Maine, that is housed in a shingled Victorian building once owned by the Daughters of Union Veterans. An ex-Coast Guardsman, Black started a small exhibit when stationed at the Boston Light in the 1960s. He took the exhibit with him when he was transferred to Rockland in 1968 and it has remained there ever since, growing into the most extensive collection of lighthouse artifacts in the country. It contains just about everything an old lighthouse would have contained: lanterns, lenses, bells and bell strikers, brass oil cans, keepers' uniforms, utensils, tools and foghorns that sound off every so often. Black has on display a modern fog detector in working order, along with an explanation of how it works. He also has more mundane items, including a dustpan. "Every lighthouse had a brass dustpan," he explains. "It was the first thing the inspector asked to see. It was supposed to be carefully shined. If it wasn't shiny, the inspection was off to a very bad start. They conducted true white-glove inspections of lighthouses in those days. Where the inspector looked, angels feared to tread."

Between 1910 and 1950, about 60 squat, ungainly-looking vessels served as floating beacons far offshore where lighthouses could not be built. Lights were prominently displayed on their masts, which also bristled with communications and meteorological devices. Those lightships were required to absorb terrific punishment during storms rather than relinquish their position; more than a dozen were lost, some taking their crews with them. Others were rammed in bad weather by larger vessels. Even under ideal conditions, the lives of close confinement led by crewmen aboard lightships were uncomfortable, monotonous and stressful. Opportunities for diversion were few.

Ken Black commanded a lightship for several years in the 1950s and his hearing, he says, has never been the same. "The foghorn on deck was pointing right at my bunk," he recalls. "It shook the whole ship. And you had to learn how to talk with the signal. When you were having a conversation, you'd automatically stop every 25 seconds, wait for 5 seconds while the horn sounded, and then resume talking, just as if nothing had happened."

Wayne Wheeler's latest project is the restoration of the 128-foot, 600-ton lightship *Relief*. It was donated to the U.S. Lighthouse Society last year by a wealthy California businessman and it is slated to begin a new life soon as a floating museum at the Oakland wharf. But this time the irrepressible Wheeler may have bitten off more than he can chew. A paint job and an overhaul will cost more than $40,000. Insurance alone adds up to $6,500 a year, and that will jump to $14,000 when the ship is opened to the public. "I never really had any money worries about our organization until we took this thing on," Wheeler complains.

Notwithstanding that concern, Wheeler is optimistic about the future of lighthouse preservation. He believes public support will continue to grow because so much romance is associated with the old beacons. "They inspire people," he says. A woman in Sacramento put it this way not long ago in a letter to Wheeler: "As a disabled person, I have not been able to go into a lighthouse. I look at them from a distance and am grateful for the spiritual sight of them." "I've never seen a lighthouse," wrote another society member in Kansas, "but I've always loved them."

Picturesque silhouette at South Haven, Michigan, adds a painter's finishing touch to Great Lakes sunset.

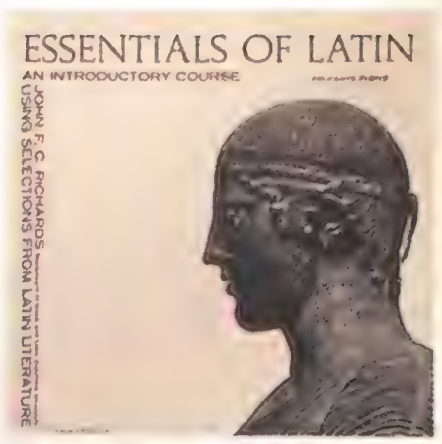
By Tony Scherman

This man captured the true sounds of a whole world

Nothing less was the aim of Moses Asch, a curmudgeonly but dedicated genius who ended up creating Folkways Records

On a chilly, bright day late in 1986, flame-colored leaves went skittering down Second Avenue. Manhattan's East Village—the country of the young—bubbled as usual with health food restaurants and street guitarists, Off-Off-Broadway theaters, and new boutiques. Just below Ninth Street, 50 men and women gathered inside a funeral home. Prosperous looking, mostly gray-haired, they were actually far less conventional than Second Avenue's latter-day bohemians. Unknown to the students and musicians hustling past, inside the chapel sat their forebears, the architects of their nonconformity.

Lame and grizzled, Pete Seeger brought his banjo. Alan Lomax was there too—perhaps America's greatest folklorist, he discovered Woody Guthrie and Leadbelly. So was Lomax's sister Bess Hawes, 40 years after joining Seeger and Guthrie in the pioneering Almanac Singers. Sam Goody, once America's most powerful record dealer, came to say good-bye to a friend of 50 years. Samuel Charters, record producer, author, permanent avant-gardist, laid a second father to rest. Each mourner was a mirror, reflecting no more than a few facets of the brilliant, flawed man whose



Opposite: Asch in 1980. He recorded everything from American Indians to Eleanor Roosevelt—songs, poems, lectures, interviews, readings, even animal sounds—more than 2,200 albums in all.

death brought them together. Moses Asch's dreams were so big, these others had all fit inside them.

Asch was a businessman, but his enterprise was more epic poem than corporation. Folkways Records is the greatest collection of folk music ever made available to the buying public. All 2,200 albums have stayed in print—that was the stubborn way Asch did business. From Woody Guthrie to Ghanaian war drums to Afghani teahouse music, the Folkways catalog is a triumph of detail. Joyful, mysterious, discordant, whispering, shouting: the voice of Man.

Asch's parents, noted writer Sholem (right), Madja, share one of many theater premieres with a friend.

"If I were to name a hundred great records of the world's music," says ethnomusicologist Steven Feld, "40 or 50 would be Asch's." Asch shamed universities and museums, and he did it alone, once bankrupt and usually strapped for cash. When he died last October at 81, the Smithsonian was concluding negotiations to purchase (and now owns) Folkways, pledging to preserve—and enlarge—the legacy that Asch, in a better-than-average play on words, called his "mosaic."

Early for the funeral, Samuel Charters had stood under the autumn sky and suddenly thought to himself, *My God, this is where Moe got his start.* Few knew it, but almost 60 years before, Asch had indeed made his first dollars right here, rigging primitive sound systems for Yiddish theaters and burlesque halls. Back in a different, pre-Depression New York, when the nearby Third Avenue El still clattered overhead. Back when America hardly knew it had its own homegrown music.

Moses Asch was always partial to the blues, so up to the funeral chapel's podium stepped children's singer Ella Jenkins. She took a harmonica from her suit jacket; its thin salty notes rose through the silence, dying away. It was "Railroad Blues" she sang, one of the first, simplest blues, old as the century, a steam whistle calling in the night:

> I hear that old freight train
> Comin' down the line.
> Well, I wonder if that train's
> Gonna bring back that pal of mine. . . .

Madja Spiro was a young beauty of the Polish city of Lodz who proudly traced her 300-year Jewish ancestry. In 1899 she married, and tamed, Sholem Asch, carousing scion of strict Hasidim—and a literary prodigy, famous at 18. Four children came: Nathan, Moses (always called Moe) in 1905, then John and Ruth. Sholem's fame blazed—critics of the 1930s ranked his trilogy *Three Cities* with the novels of Thomas Mann. Glamorous, mutually absorbed, Sholem and Madja (left) globe-trotted, shuttling—or stranding—their children between Warsaw, Paris, London, New York. "Most children leave home," says Moe's brother, 80-year-old John Asch. "Ours was always leaving us." Sholem and Madja's bicontinental soirees sparkled with the likes of David Sarnoff, Chagall, Toscanini and Alma Mahler; wide-eyed, the Asch children would crowd the banister. After such a childhood, Moe was much more cosmopolitan than most of the artists he recorded—and he hated to travel.

Sholem was a tyrannical father. His eldest, Nathan, became a writer and spent a wretched life alternately vilifying and worshiping the almighty Sholem. Moe's instincts were cannier. In practical matters, Sholem was helpless, so Moe made careers in business and

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Ella Jenkins, genial children's singer, first recorded for Asch in 1957. Her albums sold well and helped him keep Folkways afloat. Unlike commercial producers, she says, "Moe never put any stops on my style."

technology. He was very much a writer's son. "I'm not interested in music per se," he once said, "but in the literature of it, the words." Yet it was the *spoken* word he loved. Moe's passion for oral literature—folk music—was a way to emulate *and* rebel against Sholem, to compete without competing. Moe's hunger, as ravenous as Sholem's, was for the tangible, not the conceptual: "Moe wanted to *touch* the art, *hear* the sound, *hold* the book," says his anthropologist son, Michael. "He was just voracious."

He never really escaped Sholem. Folkways' grand achievement has its dark side: a grim, Sisyphean effort to win the esteem of an overbearing, very famous father. Bullied early, he became a gruff and lonely man. "Moe was always bitter," John recalls; "he never really reached out to anybody." And Moe's rages rivaled Sholem's: Folkways' founder bellowed wildly, ripped telephones from walls—Moses railing at the Philistines. "Moe discovered early on," says Charters, "that in real crises—like copyright holders demanding royalties—he could terrify people by screaming. I've seen him drive them out the door, waving an 8-by-10-inch American flag and yelling about his rights as a creative artist."

Another early relationship mattered. Moe's remarkable aunt, Basha Spiro, was a professional nurse and an ardent Socialist. After the revolution she went to Russia and became a Soviet government official. In New York in 1918, Moe badly broke his leg. Doctors counseled amputation, but under Basha's care Moe emerged not only ambulatory but a lifelong Socialist—passionate, though nondoctrinaire. Actually, Aunt Basha may have merely been a mild catalyst. "Don't ever forget," says Alan Lomax, "that Moe Asch was a Polish Jew. And in those days, in Warsaw, or in New York's Lower East Side, if you weren't a Socialist, you were a *jerk*."

By the early 1920s, Moe was in Germany studying acoustic engineering. On a 1923 vacation in Paris, he happened onto a used book in a bookstall beside the Seine: *Cowboy Songs*, the 1910 work of America's first great song collector, Texan John Lomax. The book's preface was by a failed rancher of some note—Theodore Roosevelt. In an inspired insight, TR likened Jesse James and cowboy balladry's other badman-heroes to the outlaws of medieval Europe.

Tony Scherman is a journalist of American music, from jazz to folk to pop. He wrote for SMITHSONIAN *about song collector Cecil Sharp in April 1985.*

Nuclear energy helped America achieve its energy balance. Is it a balance we can keep?

The 1973 Arab oil embargo forced America to turn to alternatives to foreign oil. Reliable alternatives. America increased its use of electricity from nuclear energy and coal and began to make important strides toward energy independence.

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In 1939 Asch took a chance recording ex-convict Huddie Ledbetter's children's songs. The records didn't sell and Asch was attacked for giving "a killer an audience," but he'd found a life's vocation.

Asch always dated his interest in folk music to that Paris day. "It amazed him," reflects Pete Seeger, "that America had such a low regard for its own history. As a Jew and a European, he had a *high* regard for *his* history. But America, with so much energy and power, seemed merely to careen from one adventure to another, forgetting its own traditions." Traditions that Lomax's big book helped unveil.

Others would take Lomax's path, too. As the country began fighting off the Depression, artists and intellectuals, a good many of them supported by the government, spun a rainbow vision of a heroic, sprawling, workingman's America. To these voyagers, folk music was a precious new resource. Enthusiasts like Lomax *père et fils*, musicologist Charles Seeger and his Harvard-dropout son, Peter, piqued the public's interest—especially the literate, left-leaning public—with folk music songbooks and festivals. Married now, owner of a little West 46th Street company making sound-recording gear, Moe started turning up at concerts. Without fanfare (or impact), a record called *Jewish Folk Songs* by an aptly-named aggregation, the Bagelman Sisters, slid onto record-store shelves. The producer was Asch Records, West 46th Street.

And into Moe Asch's life came an outlaw-hero straight from Teddy Roosevelt's preface. Huddie Ledbetter didn't learn guitar in any classroom. In 1939 he was six years out of Angola State Prison Farm in Louisiana, a two-time convict and rumored seven-time killer. He'd survived stabbings, beatings, a slit throat (a thick, lurid scar ran from ear to ear). White-haired but barrel-chested at 54, he still carried his prison strongman's nickname—"Leadbelly." He'd sung his way out of both jail terms: in 1923, using his most ingratiating minstrel's manner on the visiting Governor of Texas ("Please Gov'ner Neff, be good an' kind/ An' if I can't get a pardon, won't you cut my time?"), and in 1933, astounding John and Alan Lomax when the folklorists found him at Angola. In time, Leadbelly headed for the nascent folk music capital, Manhattan, and met Asch.

Even past his prime he was a stunning performer, commanding a wide repertoire of blues, Anglo-American ballads, cowboy songs, slaves' field hollers and his own tunes—"Bourgeois Blues," "Cotton Fields." Proper New York liberals shivered at "Fannin Street," a song about his youth in the whorehouse district of Shreveport, Louisiana. But he couldn't make a living

in Manhattan. On and off welfare, he took a fourth-floor walk-up on East Tenth Street, between Avenues B and C. When Pete Seeger met him, "Leadbelly was trying *very* hard to make it; I never saw him without a crease in his suit. Yet what came out of his mouth, and out of that big 12-string guitar, was wonderful, Southern Afro-American folk music. Nobody today can play with Leadbelly's pure, straightforward power. He was fantastic. Moe Asch was appalled that he wasn't being recorded. Here was a job that needed to be done and Moe had a recording machine."

The resulting album of children's songs caused a stir. Walter Winchell fulminated about a killer loose among the young. To *Time*, Leadbelly was "a coal-black, swampland Negro . . ." who "drawled his rhyme-sprouting improvisations" and couldn't stay out of jail. Yet what impressed Asch about Leadbelly was precisely his *gentleness*. "Kids adored him," says Seeger. "Here this man who'd been in jail much of his life was just great singing for children." Slyly, Asch was taking aim at racism. Bravely, too. In 1939 there was a certain chutzpah in releasing an album of children's songs by a convicted black murderer.

Huddie Ledbetter never lived to see the folk revival he helped kindle. Too exotic for white pop-music audiences, the old man was too rustic for urban blacks (a Harlem audience once booed him off the stage). Leadbelly's only fans were the literati. He died in 1949, still on welfare. Months later, the Weavers turned his "Goodnight Irene" into the best-selling song in America.

"Moe loved having *to get it right"*

Cutting Leadbelly albums, Asch had found his vocation. "What Moe really liked," says Bess Hawes, "was the *act* of recording. Just getting someone into that studio and getting behind his recording machine." For him, engineering records was a no-frills, documentary job. Magnetic tape was not used until the late 1940s; instead, a needle traced sound vibrations onto wax- or acetate-coated disks. A fluffed note or an engineer's slip—and the disk was ruined. "Moe loved *having* to get it right," says Michael. Yet willfully, he ignored technical advances in hi-fi and stereo, and his records often lacked sparkle.

One day early in the 1940s, a little wild-haired man breezed into the tiny 46th Street studio and plopped right down on the floor. "I'm Woody Guthrie," he said in a dry twang. "I'm a Communist." He carried a Gibson guitar; Asch peered at a printed inscription stuck to it: "This Machine Kills Fascists." The stickers, produced for war workers, were normally seen on lathes and drill presses.

Shrugging at the fools he suffered, Asch set up his

Like Asch, Pete Seeger, a Folkways star in the late 1950s, saw the company as a voice for social justice.

Sam Charters produced many albums, but kept his distance: "Moe," he says, "wasn't easy to work with."

In the office, Asch consults with Harold Courlander, far-flung editor of the Folkways Ethnic Library.

recording gear and listened. And listened. Not only were the little man's songs riveting, but he wouldn't stop! Guthrie was incredibly, unendurably prolific. "He had more songs than you'd ever want to listen to," says Bess Hawes. Some, like the workers' hymn "Pastures of Plenty" were quiet and terse. Some, as when Woody whooped his paean to "that wild and wasted stream," the Columbia River, in "The Grand Coulee Dam," burst with a Whitmanesque prolixity:

> In the misty crystal glitter of that
> Wild and windward spray,
> Men have fought the pounding waters
> And met a watery grave,
> Well, she tore their boats to splinters,
> But she gave men dreams to dream. . . .

For ten years, Asch recorded everything Guthrie brought him, releasing 11 solo albums and dozens of collaborations with Cisco Houston, Seeger and Leadbelly. Waiting for the BMT subway to 46th Street, Woody would bounce his guitar on the concrete platform, announcing, "Can't break a Gibson! Toughest machine made." Asch's gruff reserve softened when the scrappy Oklahoman came around; he listened to Woody's troubles, corresponded with him, fed him. During the mid-'40s, with Guthrie distraught, sick or drunk, and unable to perform, Asch put him on a $40-to-$50 weekly salary. Guthrie's job was to show up every morning and record his entire output (most of which Asch had already recorded). It was only Asch's way of keeping Woody out of trouble. Or was it? One of the few songs new to Asch was a simple, six-note melody. Seeger dismissed it as "one of Woody's lesser efforts." Asch loved it. It was "This Land is Your Land."

In 1944, Asch Records became Disc. The 46th Street studio was still a maelstrom of unanswered letters, recordings unmarked and mislabeled, gutted turntables, wandering minstrels—and Moe Asch: swarthy, heavy-set, Yiddish-accented; half creative soul, half music-biz tough hollering into the phone at record pressers, album-jacket manufacturers, label makers: "Schmuck! Where are my goddam records?" Steadied by invaluable and long-suffering assistant Marian Distler, he stormed passionately through 16-hour days.

Forty years later, considering the unheralded talent he championed, Asch's instinct for greatness seems astounding. Yet in 1947, Moe Asch was going broke. He aimed for the big time. Lowering prices to compete, and beefing up advertising, he sold more records than ever—and promptly lost his shirt. What went wrong?

"Moe was a lousy businessman," says Sam Goody.

Alan Lomax discovered singers like Leadbelly and Woody Guthrie, then fervently promoted their work.

But before any other record man, Asch glimpsed a truth of the dawning era of corporate giants. The business world was splitting into two tiers, the huge and the very small. He'd been wrong, he saw, to expand willy-nilly, flinging himself against RCA and Columbia. Far wiser to sell a specialized product to a small, targeted audience. From the ashes of Disc rose Folkways, and its tribes increased. "Moe predated FM radio, health food, pushcart presses," says former colleague Irwin Silber. "All the people today, trying to carve out niches between the conglomerates."

His chosen market, though, was teachers and librarians. Asch periodically stowed 100 albums into a steamer trunk and, conference-hopping, served as his own ad campaign, a burly, heavy-lidded man who looked like a Lebanese boxing promoter but could discourse with avuncular charm on Charles Ives, Chippewa healing songs or Azerbaijani scales. ("Moe called everyone 'dear,'" groans longtime assistant Marilyn Averett in mock exasperation.) Armed with a Folkways catalog, the librarians went home to order —permanent customers, likely as not.

Asch was now out to capture the whole world's music. The sounds of professionals, of course, but of communities, too—"drunken farmers on a Saturday night," as Asch once put it. Folkways' new Ethnic Library swelled; today it embraces some 170 African nations and tribes, 100 albums from the Caribbean, 25 from Japan. Songs from 40 American states (Louisiana alone contributes 35 albums, Alabama 22). More than 800 ethnic albums in all. Plus the great folksingers, bluesmen and jazzmen, poets reading poems, statesmen speechifying, frogs croaking, a science series and almost 200 children's records. Sounds from the entire world—and beyond (ethereal Folkways FX6200, for one: *Voices of the Satellites*).

Harold Courlander, a shoestring genius after Asch's heart, joined him in 1947 and coined the name Folkways. Novelist and maverick scholar, he'd globe-trotted since 1932, nervously stretching pea-size grants to cull songs from everywhere; his recording gear had melted in the Caribbean heat and been blown up by Japanese torpedoes off Madagascar.

He and Asch cultivated a worldwide network of traveling scholars. Some were eminent: Alan Merriam, late dean of American ethnomusicology, and pygmy expert Colin Turnbull. The musicians were equally fine. Joseph Spence, a Bahamian guitar genius, became a musicians' hero in America. Hearing Spence in 1964, today's blues-rock guitar master Ry Cooder dropped everything. "This was way more interesting than anything I'd heard before," he says. Re-

corded in her hut in 1966, 90-year-old Lola Kiepja, one of eight surviving Selk'nam Indians of Tierra del Fuego and the tribe's last *xo'on* (shaman), chanted words of her dying tongue in a leathery growl: "My body is in darkness/ I am myself to pierce it with an arrow." From prehistory, her *xo'on* forebears had purged themselves by gouging a channel across their chests.

Few of Folkways' records sold more than 500 copies; a third sold under a hundred copies a year. Asch

Asch kept gifted but erratic Woody Guthrie recording in the 1940s. One result: "This Land is Your Land."

didn't care. As long as he didn't go bankrupt, amassing the collection was more important than selling it. His compilation slowly turned into a lexicon of hope, fueled by his old-time visionary radicalism. "He was making a dictionary," says Michael, "and one with a populist intent—when everyone finally understood each other's voices, the world would be at peace." Accordingly, Asch refused to delete a single album from Folkways' catalog. It didn't matter if it went unsold for years. "What *good* is the collection," he'd say, "if this tribe isn't in it? Do you delete the letter *Q* from the alphabet just because you don't use it as much as the others?" He drove Sam Goody to despair. "I'd say, 'Moe, this record's a *stiff*! Drop it!' He'd look at me, horrified: 'Drop it?' Like he was Abraham and I'd asked him to kill his son."

Asch was fonder of his collection, musicians grumbled, than of them. He had a vexing habit—artists didn't always get paid. In the early days, Bess Hawes recalls, "unless you made a special arrangement with Moe, he didn't pay royalties." Things hadn't changed much by the late 1950s, when blues singer Dave Van Ronk and Asch used to conduct a mutual charade. In a special Salvation Army-bought "Moe Asch Collecting Uniform," Van Ronk would wait for Asch's office to get crowded. In he'd stagger in his rags, croaking pathetically, "Moe—you're not paying me."

"Oh, *Dave*. I'm just making up your royalty statement now." Snatching up a random piece of paper, Asch pretended to scan it. "Says here I owe you 75 bucks." Then and there he'd write Van Ronk a check. A real royalty statement, of course, never existed. Financially, Folkways was less a corporation than a feudal patriarchy. "Moe poured every penny he could back into that business," notes Seeger, who rarely got a royalty statement. "He did lots of the dirty work himself. Here was a job that needed to be done, and nobody else was doing it. The Musée de l'Homme, the Library of Congress—oh, they claimed to be doing it."

Moe galloped and did the job

"But they had *piddling* small catalogs compared to Moe's," Seeger goes on. "All these multimillion-dollar operations were inching along, and Moe was just galloping, he was doing the job—hell, *I* wasn't going to complain about royalties." Pete Seeger left Folkways for awhile, but he and Asch stayed in touch. Seeger became a hero. Asch went to the office every day, opened the mail. And wound up a hero, too—a grumpy overweight hero, stubbornly squeezing all Earth through a two-bit recording studio.

The Smithsonian's acquisition of Folkways will guarantee Asch's recordings a continued audience all over the world. "We'll carry on where he left off," says

the man who negotiated the deal, folklorist Ralph Rinzler, the Institution's Assistant Secretary for Public Service. Additions to the Folkways catalog will be made from existing tapes and, eventually, new recordings. "Besides," Rinzler adds, "Michael and Frances Asch—Moe's son and widow—have given us the Folkways archives. That's a vast collection of unreleased recordings, original glass disks, letters and documents. It will be a treasure trove for researchers for years to come."

Scholars and schoolchildren are not Asch's only beneficiaries. Twenty years after America's folk boom, the popular-music mainstream is once again finding its way to Asch's door. Late 1980s pop music is increasingly international, an intraglobal stew. Just as in the late '50s the young Bob Dylan devoured Guthrie's ballads of Americana, so Folkways is a rich ethnic source for musicians all over the world today.

When he met Moe Asch, Seeger was amused. "Here was one more quixotic venture doomed to defeat: a fellow who knew next to nothing about selling records, trying to sell records. Everyone said, 'Moe, how can you stay alive selling a hundred copies of a record a year? Moe, wake up! Moe, you're a dreamer!' And by the time he died, they were ready to give him some kind of Nobel Prize."

Portrait of a man at work. Asch's equipment stayed no-frills basic to the end—partly because he said hi-fi and stereo produced an inauthentic sound, partly because he was often too strapped to buy fancier gear.

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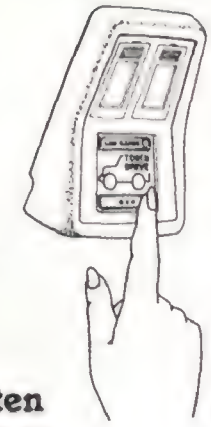

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PURE VIRGIN WOOL

In Tulelake, California, field researchers prepare for spraying of Ice-minus bacteria on potato seedlings; potted bean plants in foreground, called trap plants, will be tested later to check on spread of bacteria.

By Stephen S. Hall

One potato patch that is making genetic history

Release of genetically altered bacteria into the environment is a small experiment with huge implications—and hotly debated risks

Tulelake, California, pop. 914, lies in a lovely, lonely, faraway corner of northern California, where the local newspaper is the *Lost River Star* and the most exotic tourists tend to be the red-breasted mergansers and cinnamon teal dabblers and other waterfowl passing up and down the Pacific flyway. Once a vast lake bordered by tule reeds and plied by Modoc Indians, this part of the Lower Klamath Basin is now a broad fertile agricultural plain that is particularly well suited to growing a tuber of great local pride—the Tulelake potato.

And truth to tell, outsiders never used to pay much attention to Tulelake's potatoes, save the odd scavenging migratory bird. But beginning in 1982, the tourists have included government officials, research scientists, representatives of the national media, and even environmentalist vandals, all because of a circumspect little bacterium known as *Pseudomonas syringae*. University of California, Berkeley, researchers, perhaps the most distrusted interlopers of all, wanted to apply those microbes to a small, isolated test patch of potato plants in Tulelake to perform one of the first official releases of genetically engineered microor-

Photographs by George Olson

Keith V. Wood

Tobacco plant with firefly gene glows in the dark (picture is a 24-hour exposure).

ganisms into the environment. This visitation was not merely microbial in nature. Tulelake was visited, as towns before it had been and as towns afterward surely will be, by the revolution in biology known as recombinant DNA.

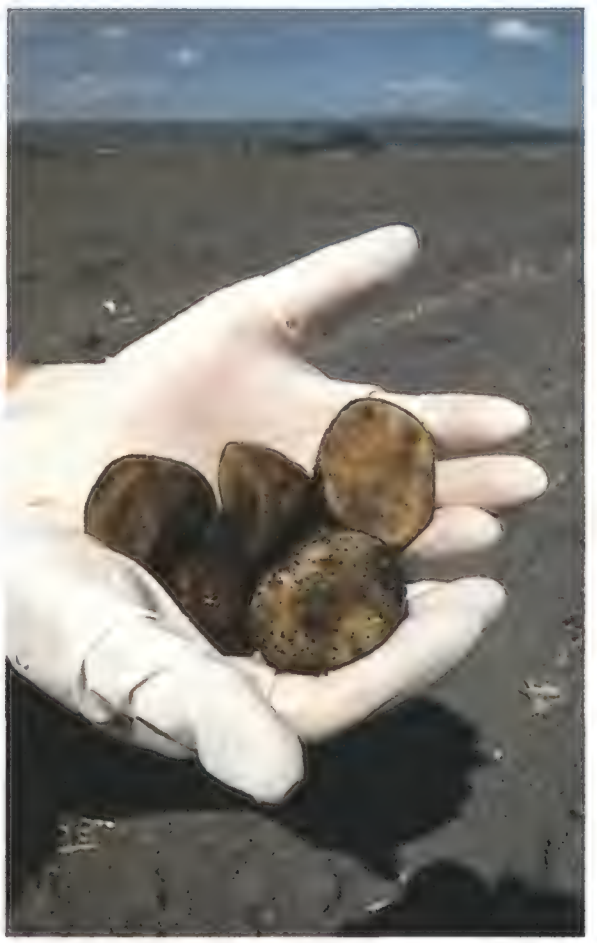
Known informally as gene-splicing, recombinant DNA is a technology that has allowed scientists to examine the fundamental material of heredity, the long molecule of deoxyribonucleic acid (DNA) that makes up the chromosomes of all living things. By tinkering with DNA and recombining its elements, biologists have rapidly discovered new applications of this technique, which touch everything from basic research to genetic screening to the production of pharmaceuticals and biological pesticides. Recently, for example, scientists were able to transplant into a tobacco plant the gene that makes a firefly light up—giving them a light cue to genetic activity in the plant as it "flashes" on or off. And it appears that human-gene therapy, a kind of surgery at the level of cells, will soon be attempted to treat genetic disorders.

These promising developments do not come without potential risks, however, and the fear this type of research provokes can lead to awkward encounters between science and society. Indeed, the interaction often has the sound of a forced marriage. There was plenty of awkward and angry interaction on a cold Saturday afternoon last January, when townspeople from Tulelake trickled into the Home Economics Building of the Tulelake-Butte Valley Fairgrounds to try to come to grips with this brave new world of modern biology. Where once they merely fretted over rainfall and bank loans and market prices, now they had to grapple with the release of genetically altered material —with pathogenicity and deletion mutants—and what one citizen described, more than once, as "recumbent DNA."

The farmers, housewives and county officials showed up to reply to an environmental-impact report prepared by UC-Berkeley—about an inch thick, some 500 pages long—which claimed that the planned experiment posed no harm to humans or to the environment. The turnout was small, but unanimously leery in its view of the field test, during which potato seeds would be coated with genetically altered bacteria designed to protect the plants against frost damage. The emerging seedlings were to be sprayed later on with the same bacteria.

The head of the Tulelake Grange, 82 members strong, led off a parade of grassroots refuseniks by announcing his group's opposition to the experiment. The president of the Tulelake Growers Association, representing 100 farms in the area, said publicity about the experiment had created a negative marketing image for the Tulelake potato, adding, "We suspect that we might be hammered, in other words, in the marketplace, and for that reason we are opposed." (Indeed, rumors later circulated that wily potato farmers in Idaho had already prepared a label, to be placed on packing boxes and bags, that read: "Idaho Potato Grown in Mutant Bacteria-Free Environment.") A housewife and secretary named Ava Edgar, who was representing the Concerned Citizens of Tulelake, said that the university had neglected to provide a worst-case scenario for the test. "Certainly there must be something negative about the experiment," she insisted.

And then a young bearded farm laborer named David Porter Misso zeroed in on the equivocating vocabulary used by scientists when they try to translate the statistical language of risk into the everyday language of social impact. "Having read all the [reports] . . . I find words like 'should,' 'expected them,' 'no foreseeable risk,' 'infinitesimal,' 'probably is very low,' 'not much likelihood,' 'however is low,' 'should not,' 'doubtful,' 'slight'. . . ." Misso paused and looked up from the piece of paper he held in his hand. "You know, I'm not a scientist, but those words don't say yes or no. I thought the whole



Tulelake potato seed pieces were coated with a solution of Ice-minus bacteria.

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Farmer Walt Meshke argued at hearing, "This bug has to eat on something!"

reason for that impact report was to come up with yeses and noes. We didn't get any yeses or noes."

Finally, after more than an hour of similarly plaintive testimony, a farmer named Walt Meshke (above) in down jacket and jeans, with a fertilizer-company cap perched on his head, sidled up to the microphone. He pointed out that *Pseudomonas syringae*, the microbe in question, grows very well at 35 or 40 degrees F. "The potatoes are stored in the potato to shed at about 35 or 40 degrees, and what happens in there?" he questioned. "This bug has to eat on something! What happens to these potatoes?" And, he also wanted to know, "has anybody spent any time in a building filled with these rascals for, say, 24 hours?"

The answer, in a sense, is yes. Steven E. Lindow, a plant pathologist at UC-Berkeley, has spent more than ten years studying "these rascals" and it is his experiment that has caused all the fuss. "Certainly there are other parameters besides scientific questions that have to be addressed," Lindow says. "But when you have lay people standing up and saying they need to make the decisions—they're not equipped to do so. It's a little absurd. I mean, I would hate to stand up and say I need to be directly involved in the regulation of nuclear power plants, because I know nothing about them."

That deference to expertise, so ingrained in the scientific community, sounds positively undemocratic outside it, and the fear of unexpected calamity weighs heavily on the public. In early 1986, when a similar field test nearly got under way in Monterey County, south of San Francisco, local officials voted to ban the test with a novel legal interpretation. Bacteria, they argued, were animals and thus subject to the county's land-use restrictions. They were never fully convinced that the experiment was without risk.

"I was 95 percent convinced that there would be no harmful damage to the environment, maybe 99 percent," recalls Sam Karas, then chairman of the county board of supervisors. "The question came up about that one percent. There are no guarantees in life, but I wanted one and the scientists wouldn't guarantee that it would be 100 percent safe."

"Rarely am I 99 percent certain of anything," says Robert K. Colwell, an ecologist at UC-Berkeley, who has assessed the ecological risks of both the Monterey and Tulelake experiments. "The public accepts significant risks every day—flying in airplanes, driving in cars, eating certain foods. But they accept those risks by individual choice. Here, they're having the risk imposed on them, and I do not think the benefits are at all clear."

Benefit, of course, is in the eye of the beholder. The potato farmers of Tulelake have for years used a tried-and-true sprinkler system to protect their crops from frost, so bacterial protection promises no agricultural advantage and represents a huge public relations nightmare (even though the only potato plants getting the treatment would be university test plants that would be destroyed after the experiment).

In a larger sense, one could argue that the benefits have never been entirely clear to the public. Ever since 1973, when Stanley Cohen at Stanford University and Herbert Boyer at the University of California, San Francisco, and their colleagues first demonstrated that DNA from two different species could be recombined and duplicated (a process called cloning), the public has reacted to this emergent technology with a mixture of fascination and dread. They have been told that recombinant DNA promised a vast trove of wonder drugs and agricultural benefits, as well as boons to basic research; they also heard concern that such experimentation might inadvertently create epidemic contagions by novel organisms. Some people even questioned the philosophical right of biologists to tamper with nature in such a fundamental fashion. The scientists observed a moratorium on certain experiments during 1974 and 1975, and several city council hearings in Cambridge, Massachusetts, in the summer of 1976 brought the issue to national attention.

Now, more than ten years after some critics argued that the technology should be banned, recombinant DNA has revolutionized biology to a

Gary Wagner/Sygma

Genetically altered bacteria in a lab dish number approximately 200 billion.

Stephen S. Hall's new book on genetic engineering, Invisible Frontiers, *is published by Atlantic Monthly Press.*

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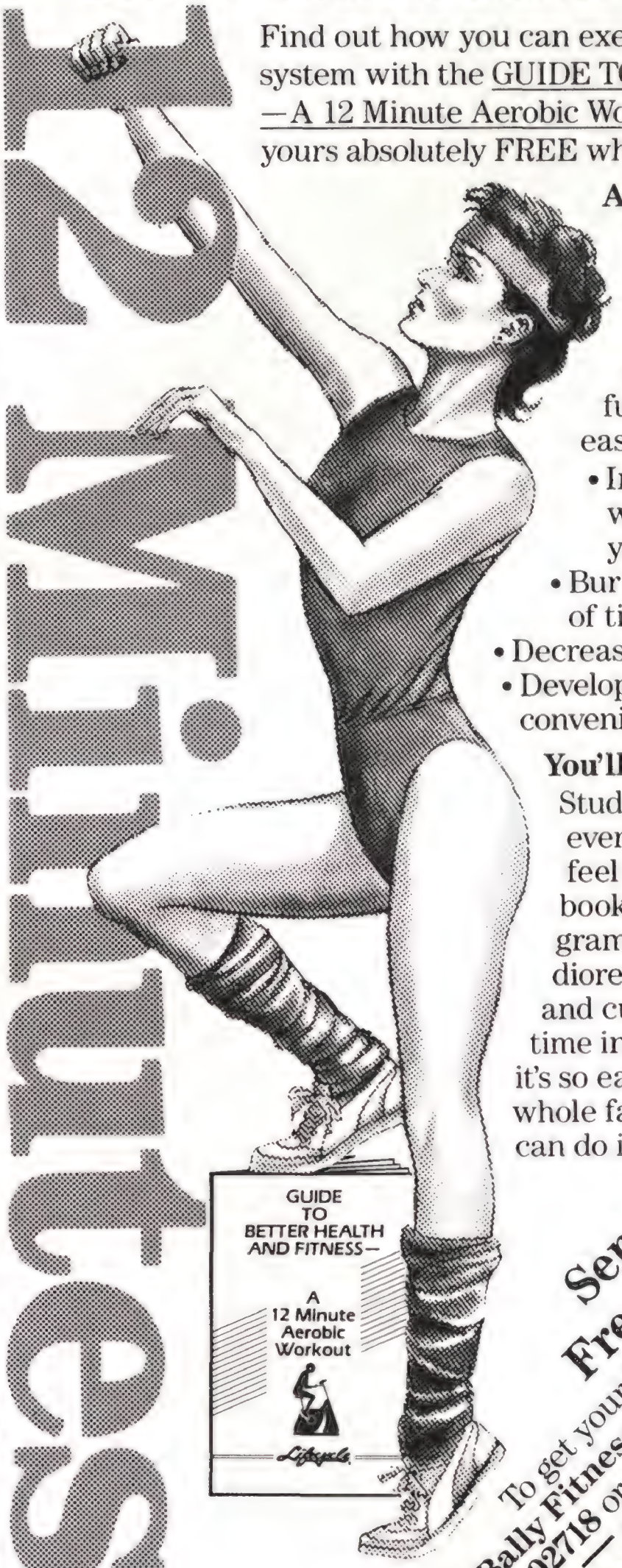

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Gary Anderson, a UC-Berkeley scientist, nets insects in a field before spraying, for comparison with the bugs to be caught later.

degree perhaps unprecedented since the invention of the miscroscope. And not a single report of illness or death has been associated with the technique. Drugs of great promise are already being used in clinical trials. To name but two: a protein that dissolves life-threatening blood clots during heart attacks, and a hormone known as "epidermal growth factor," which may speed the recovery of wounds and burns. Genetically engineered human insulin, human growth hormone, and hepatitis B vaccine have been available for several years.

But perhaps of greater importance, at least to many scientists, is the wealth of basic knowledge about the natural world that has accrued in the past decade. Like the python that ate a pig, biology is distended with data, still digesting its huge initial meal of information. For example, scientists are now getting a glimmer of understanding about how protein molecules and DNA interact, an important step in learning how genes are read (or "expressed") in individual cells. And our knowledge of the AIDS virus—and ultimately any hopes of disarming it—would be virtually nil without gene-splicing.

Unfortunately, many of the breakthroughs are so complex and esoteric that the general public has had to take the benefits on faith, and faith has been in relatively short supply. In an era when "Three Mile Island" and "Love Canal" are buzzwords for new technologies run amok, genetic engineering suffers anticipatory guilt by association. It may be, however, that recombinant DNA is the most closely scrutinized new technology in the postwar era.

"We've certainly paid more attention to this one, on the way in, than we have with others," says Stanford University professor Paul Ehrlich, an expert on new technologies and their ecological repercussions, "but that doesn't mean there won't be potential problems to deal with. We have too much of a tendency to give credibility to the people who advocate a new technology, and who have a financial stake in it. The side of caution is nowhere near as well financed or motivated, and so that's why government must step in. These risks should be handled in the same way as any other environmental hazard, with an environmental-impact report, with very careful supervision and with heavy penalties for those who violate the law."

Corporate adventurism has earned an extra dollop of public cynicism. In 1985, a California-based firm called Advanced Genetic Sciences Inc. (AGS) gave the biotechnology industry a black eye by testing Frostban, their own version of an antifrost bacteria, on the roof of their Oakland headquarters. Against common sense, to say nothing of appearances to a nervous world, AGS scientists claimed that injecting the bacteria into trees in the open air did not constitute an environmental release. The EPA begged to differ, fining the company $13,000 and withdrawing its permit for a field test; temporarily, as it turns out—on reflection, the agency determined that the company was guilty of misinterpretation, not intent to mislead.

The company had also outraged officials in Monterey County by planning to test their so-called Frostban bugs on a strawberry patch in the heart of the county, which is the fifth most productive agricultural county in the nation, with annual farm income of about $1 billion. The company's refusal to disclose the location of the test site infuriated local politicians, especially when they finally learned that it adjoined a residential area, on land owned by an employee of the company. "Those guys couldn't test-drive a Chevrolet in this county without a use permit now," says Monterey County supervisor Marc Del Piero. AGS had to conduct their experiment in Contra Costa County, which approved it after receiving assurances that the site would be closely monitored.

While AGS's regulatory misadventures have attracted most of the attention, their organisms are based on work by and licensed from researchers at UC-Berkeley who were actually the first to explore the idea of using microbes for frost protection. Nobody even knew that *P. syringae* played a role in agriculture until

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about ten years ago. That was when Steve Lindow, then a graduate student at the University of Wisconsin-Madison, began investigating frost damage in plants. He made a startling observation.

P. syringae, some strains of which are a plant pathogen, seemed to promote the formation of ice crystals on plants. Lindow's research showed that ice crystals, in order to form on plant leaves, needed a protein to act as a kind of starter seed. And that protein, Lindow discovered, was manufactured by the very bacteria, *P. syringae*, that live on plant leaves. Lindow speculates that these particular bacteria evolved their ice-nucleating protein, as it is called, to cause frost-induced cracks in plant leaves that allow the bacteria to infect the plant itself.

Since every protein in every living thing is made to order on instructions encoded in a gene along its chromosome, Lindow used recombinant DNA to identify the gene for the ice-forming protein in the chromosome of *P. syringae*. Once he had located the gene, he was able to ask a question with both biological and agricultural ramifications: What would happen if, again using genetic engineering techniques, this gene were removed?

As it turns out, Mother Nature had beaten the scientists to the punch. There were naturally occurring versions of *P. syringae* whose gene for ice making had changed, or mutated, just enough to erase the bug's ability to make the ice-forming protein. (But the bug could just as easily revert back to its normal form.) In their UC-Berkeley lab, Lindow and his principal collaborator, Nickolas Panopoulos, made that mutation more permanent. With great precision, they cut out a large chunk of the gene for ice formation, about one-third of its total DNA. This man-made mutant, an exaggerated form of the naturally occurring mutant, couldn't manufacture the crucial protein. The scientists called the strain Ice-minus.

Into the greenhouse they went to perform tests. When potato plant leaves were colonized by the hearty, ice-forming *P. syringae*, they tended to freeze at 28 degrees F. When Ice-minus strains were applied to plant leaves in sufficient numbers, they crowded out the ice-forming bacteria, and this so-called preemptive colonization allowed the plants to survive frost damage down to 23 degrees F. The difference sounds relatively insignificant; the UC-Berkeley scientists, however, estimate that frost damage annually costs American farmers $1.5 billion.

The next step, initially contemplated in 1982, was to test the man-altered bacteria in the field. Tulelake seemed the perfect place for the experiment: the climate and land use were right for the test, and Lindow had previously conducted research at the university's field station there. But a lawsuit spearheaded by Jeremy Rifkin, whose Washington, D.C.-based Foundation on Economic Trends has challenged the development of genetic engineering, initiated a tortuous four-year legal battle. Lindow, meanwhile, met with community organizations in Tulelake to describe his experiment and doesn't recall much adverse reaction. Publicity surrounding the AGS furor in Monterey County seems to have galvanized local concern, however, and some residents filed a lawsuit challenging the safety of the university's field test. Lindow, in short, ran into the Tulelake version of the one-percent dilemma.

These fears surfaced despite the fact that Lindow and his coworkers performed an exhaustive series of experiments that convinced both the National Institutes of Health (NIH) and the Environmental Protection Agency of its safety. Under laboratory conditions, they tested 67 common local plants, including every significant agricultural product in the Tule-

lake area. They consulted wildlife experts on possible effects to animal species in the region. They tested wind-dispersal patterns during spraying. No test or data suggested the bacteria were capable of causing disease in people, animals or plants beyond its well-established host range. In fact, Lindow in years past had performed a dry run of his controversial experiment in the field by using chemically (not genetically) created Ice-minus mutants, and reported no detectable levels of the bugs in Tulelake in subsequent years. Ecologists with expertise in the field say Lindow's data have been carefully and rigorously prepared.

The UC-Berkeley researchers calculated that spraying would release 6×10^{12} bacteria—six trillion cells—on the potato plants. They calculated that only 0.0000003 percent would be capable of dispersing beyond a 30-foot buffer zone surrounding the test site. In short, they predicted that less than one single bug for every 30 million sprayed, of a species of bacteria known to be harmless to Man and animals and incapable of reproducing effectively in soil, might wander off the site. To these assurances, one Tulelake resident responded, "I want a stop put to it. Put it out somewhere else, put it in Australia. . . . It does not even belong on this planet."

Clearly weary of the entire experience, Lindow could barely work up the effort to describe, yet again, his controversial experiment. With rimless glasses and beard, in jeans and running shoes, he planted his feet on his desk in his Berkeley office and talked in low, exasperated tones about the often-postponed field test. "I'm afraid the public is so poorly educated in the scientific process, and about what scientists do, that they are susceptible to the kind of rhetoric that people like Rifkin would feed them. They are susceptible to emotional arguments. Most of the arguments against this are irrational."

In truth, ecologists have raised many of the same points as citizens about such field tests. Can the bugs proliferate, spread beyond the test sites and become established in the environment? Can they harm other plants or animals in unanticipated ways? And is there any more reason to trust the pronouncements of today's biologists than there was to trust the pooh-poohing assurances of pesticide- and nuclear-industry spokesmen several decades ago?

Even the ecologists, who cavil most persistently about the narrow assumptions of molecular biologists, agree that such questions can (and should) be answered in laboratory tests on a case-by-case basis. But Lindow is not entirely incorrect, either, when he suggests that a certain emotional opportunism colors these debates: for a public only marginally conversant in modern biology (only 16 percent of American adults, according to a 1986 survey, have a "clear understanding" of DNA), critics with specific political agendas have aroused fears by citing various scenarios that enjoy virtually no con-

Steve Lindow and Caryn Pierce spray and mark week-old potato seedlings.

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sensus in the scientific community.

An obvious question lurks behind the exasperation: Who should educate the public in such matters? "It's such a big question, I don't know how you're ever supposed to address it," says Lindow. He adds later, in a low voice, "There seems to have been a breakdown in trust somewhere along the line."

Students of this sort of distrust will recognize obvious parallels with a similar controversy a decade ago. In 1976, the city council of Cambridge, Massachusetts, ordered a temporary moratorium on recombinant DNA research at nearby Harvard University and Massachusetts Institute of Technology. After studying the issue for months, the city reached a compromise with the researchers, established a regulatory commission to oversee the experimentation and ended the moratorium.

"I have a gut feeling that 10 or 15 years from now I am going to regret having worked toward a compromise on this issue," one city councillor confided to the journal *Science* in 1977, "because I think we are stretching our limits of being able to respond in a civilized way to the fruits of knowledge."

"I am less fearful about the safety issue than I was ten years ago," David Clem, former city councillor, says today. "I don't have any specific justification for that feeling, other than the fact that I have been exposed more to the practitioners and feel more comfortable with their skill and their integrity. The biggest shock for me, as a lay person who was reasonably well educated but not scientifically [educated], was the incredible disagreement within the scientific community, and the intensity of that disagreement. One is unused to having 'experts' so diametrically opposed like that."

Internecine disagreements have been a feature of past debates. Some of recombinant DNA's more prominent critics ten years ago, however, have since modified their positions. Jonathan Beckwith, a molecular geneticist at Harvard Medical School, made a dramatic speech to a National Academy of Sciences forum in 1977 renouncing the use of recombinant DNA techniques in research because, he said, "I do not wish to contribute to the development of a technology which I believe will have profound and harmful effects on this society."

An EPA employee collects air samples from Tulelake field after it was sprayed.

Now, Beckwith has adopted the technology to his own research, describing it as virtually indispensable to modern biology. He remains concerned, however, that certain applications of recombinant DNA—gene therapy and genetic screening—pose sticky social questions in the near future and deserve widespread discussion. "There are tremendous possibilities for discrimination in life insurance policies and health insurance policies," says Beckwith, "and also in the issue of amniocentesis and abortion. Who decides what is a genetic defect and who is going to be aborted, and how are the decisions going to be made?"

The current administration's Office of Science and Technology Policy issued an umbrella set of guidelines, which were published in the *Federal Register* of June 26, 1986, as the "Coordinated Framework for the Regulation of Biotechnology." The framework attempts to coordinate regulatory oversight among the EPA, NIH, Food and Drug Administration, Department of Agriculture and other government agencies. It almost instantly aroused the ire of critics: biotechnology companies claimed the guidelines were too restrictive, while some ecologists felt that they were too relaxed.

The federal framework, predictably, generated legal challenges by the group headed by activist Jeremy Rifkin. He has kept federal regulatory agencies on their toes with lawsuits that shrewdly identify procedural lapses in the regulatory process. Yet while many biologists applaud his efforts to monitor the Department of Defense as it increases its biological-warfare research, even scientists with impeccable populist credentials are troubled by the Rifkin approach. "I'm fairly convinced that there's a very strong antiscience, antitechnology attitude in what he's doing and what he's said and what he's published," notes Beckwith, a member of the Boston-based group Science for the People, "and I find it very frightening. In the long run, he could be doing more harm than good."

All of Rifkin's lawsuits and criticisms are in the service of a philosophy he calls "algeny," which likens scientists' manipulation of genetic material with medieval alchemists. "It's a future state of mind," says Rifkin, "obsessed with the idea of reducing all life from matter to energy to information, and the programming, editing and recombining of that information to create the perfectly efficient living utility, be it a microbe, a plant, an animal species or perhaps even human beings, somewhere down the line."

Some people have interpreted Rif-

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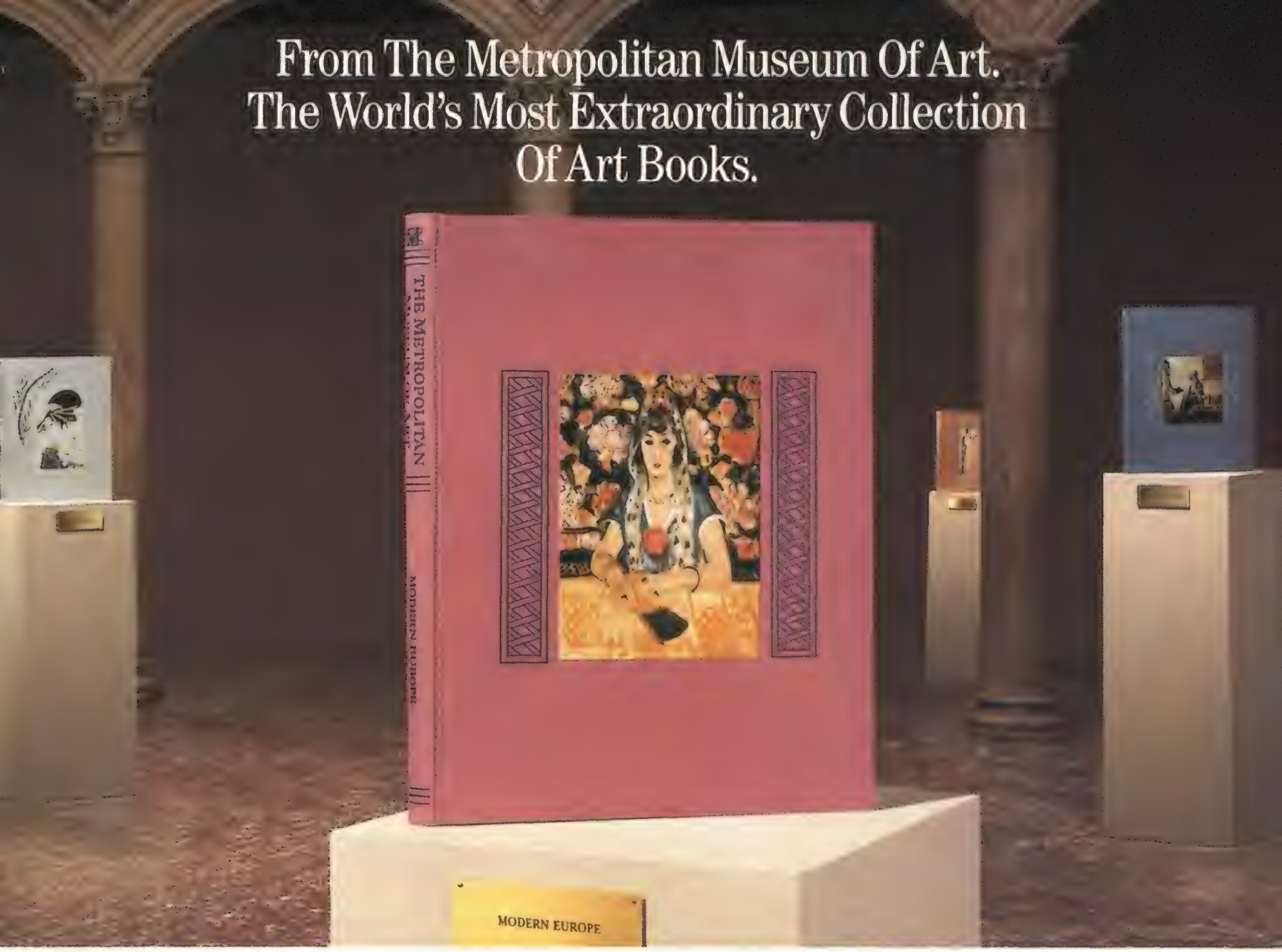

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THE METROPOLITAN MUSEUM OF ART AT HOME

Deputy sheriff Gary Barnhart checks trowels used by vandals to dig up plants.

kin's arguments as philosophical dressing on a more straightforward attempt to block all potential applications of genetic engineering. It may be that one of those people was a California judge in the Sacramento County Superior Court named Darrel W. Lewis.

On April 23, 1987, Judge Lewis concluded that an environmental release of Frostban by AGS posed no danger. In tossing out Rifkin's last-ditch legal opposition, Lewis observed, "It appears this case is more a philosophical dispute than a legal dispute." Around dawn the following morning, April 24, on a test plot outside Brentwood, California, researchers for AGS doused some 2,400 strawberry plants with Frostban and in so doing initiated the era of genetically engineered organisms released into the environment. Vandals uprooted most of the strawberry plants overnight, stripping away many blossoms; and in any event it was too late in the year for frosts to occur, so the historic precedent of the experiment probably exceeded its scientific value.

Further north, in Tulelake, it may be the academic scientists who collect the first meaningful results in the field. On April 19, when frosts still visit the dark brown earth of the Lower Klamath Basin, Lindow finally got to plant his bacteria-coated potato seeds in a small, isolated patch of soil south of town, in a flat landscape broken only by silos, telephone poles and glowering Mount Shasta to the southwest. Lindow's experiment, too, suffered at the hands of vandals, who yanked approximately half of the 3,000 potato seedlings (left) under cover of darkness. But researchers claim they successfully replanted 90 percent of the plants. On the morning of May 28 —after four years of costly litigation, data collecting and numerous public meetings; after one scientist had predicted risks of "potentially catastrophic magnitude"; and after staying up all night waiting for the winds to die down—Lindow squirted his controversial Ice-minus bacteria into the world at large. Even as the bugs crowded onto the potato plant leaves, local opponents of the test expressed disapproval of the vandalism. And Scott Keene, the attorney for the Tulelake citizens and Rifkin's foundation, told the press, "These experiments are probably safe. I'll be the first of the opponents to just out and say that."

Although the citizens of Tulelake had trouble (as would any nonspecialists) in understanding nuances in this age of genetic engineering, they seem to have grasped the historical significance much better than the biologists. Dorothy Kandra, proprietor of a farm in the Lower Klamath Basin, reflected this kind of perspective shortly after the Tulelake public hearing last January. "This is quite a history-making situation here, when you think about the ramifications," she said. "This test is an unknown. This is not an absolute necessity for us, and when we weigh one thing against the other, maybe risking the unknown is not worth it."

Many biologists would disagree with Kandra. The unknown is to the scientist, they might argue, as the soil is to the farmer—to be tilled, to be worked, to bear fruit. But perhaps the most ironic aspect of this long-running and unfinished controversy is that the brilliant minds that figured out this world-transforming technology in the first place have yet to figure out a way to ease public fears about it. Until they can make that one-percent risk appear vanishingly small rather than parlously large, science and society will continue to find themselves at odds as they walk awkwardly, at arm's length, toward the 21st century.

Before release of bacteria, pensive Lindow paces field, awaiting go-ahead from EPA.

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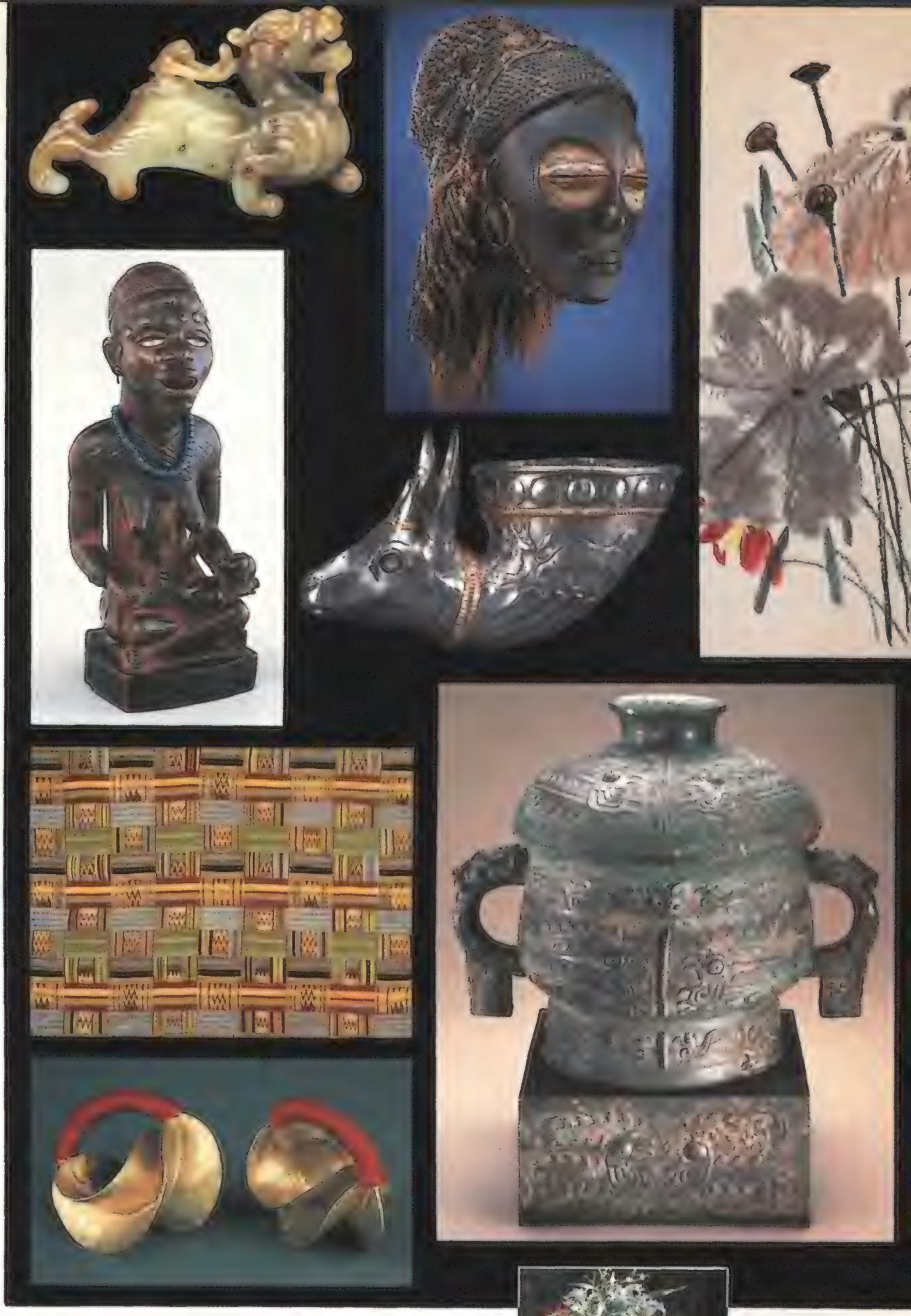

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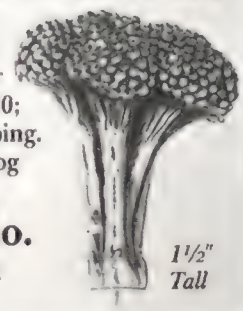

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Book reviews

Robert Graves: The Assault Heroic, 1895-1926
Richard Perceval Graves
Viking, $24.95

Ideally a biographer should regard his subject as a wife does her husband—with a love that accepts without dismissing the man's all-too-obvious flaws. A book that's too reverential makes a human being into a plaster saint, while one without sympathy or affection can read like a divorce proceeding. Richard Perceval Graves clearly tries to be fair to his uncle Robert Graves—war hero, romantic love poet, masterly historical novelist—but cannot quite bring himself to really like the man.

Still, *The Assault Heroic*—the first installment of a three-volume life—offers valuable material for admirers of *I, Claudius*, *The White Goddess* and such poems as "To Juan at the Winter Solstice." Because its author owns most of his family's private papers, he is able to present a detailed, even leisurely account of the Graves clan in the first quarter of this century. Born in 1895, Robert was part of a gifted, unusual family: his father ranked high among the popular poets of his day (many of his lyrics were set to music and became hits); his mother, Amy, second wife of Alfred Graves, could boast Leopold von Ranke, the German historian, among her relatives; and Robert's many siblings grew up to become distinguished diplomats, journalists and wasters.

The principal theme running through this account of Graves' youth is his constant need for "direction," for someone to guide his life. From birth his parents imposed a pious regime of duty and good works, turning the boy into a

Christian prig. As an adolescent at Charterhouse he hero-worshipped teacher and alpinist George Mallory—a romantic adventurer last seen alive climbing strongly toward the summit of Mount Everest. In the no-man's-land of World War I, the young Graves discovered a soul mate in poet-hero-pacifist Seigfried Sassoon. During the 1920s he attached himself to T. E. Lawrence (of Arabia fame). Marriage to Nancy Nicholson in 1918 made him domestic (four children in six years), desperate for money and happily henpecked. Even as this volume concludes, in 1926, Robert meets the near-legendary Laura Riding, the charismatic American writer who will destroy his marriage and inspire his transformation into a major poet.

For all its factual abundance, *The Assault Heroic* oddly scants Robert Graves' poetry, the central experience of his life. Yes, he leeches off his family. Yes, he's arrogant, uxorious, a bully. But the man is only the shell of the artist—and this Richard Perceval Graves fails to appreciate. For instance, his book alludes to Robert's magazine, *Owl*, but brushes over its distinguished contributors and never discusses its possible importance. Graves' poems themselves are mined primarily for biographical detail with little attention paid to their actual merits. There are only the facts, set down schematically in three- or four-page chapters: a planned collaboration with T. S. Eliot here, a visit with Thomas Hardy or Edith Sitwell there.

Finally, *The Assault Heroic* must also compete with two exceptional accounts of its subject's early life. In *Good-Bye to All That* Robert Graves composed one of the great autobiographies of the century, a classic portrait of a sensitive young poet caught up in the horror of World War I trench warfare. That book covers almost exactly the same years as this new biography, admittedly with less than perfect candor but in incomparably better prose. The other account is Martin Seymour-Smith's *Robert Graves*, a pioneering biography that not only presents Graves' whole life but also provides able and often brilliant discussions of his work.

Michael Dirda
An editor for *Washington Post Book World*

The Red Ape: Orang-utans & Human Origins
Jeffrey H. Schwartz
Houghton Mifflin, $18.95

Who among us would care to discover that our closest living relative is an occasional rapist (orangutan), a sometime baby killer (gorilla) or cannibal (chimpanzee)?

We humans care about such things. We are, regrettably, capable of all of the above sins, along with an inordinate curiosity about our origins. Midway through this at once lively and scholarly argument for giving orangutans top billing among supporting actors in the saga of human primates, anthropologist Schwartz allows one of his colleagues and many critics, Matt Cartmill, to remark that "the wish to understand man's place in nature has drawn scientists in disproportionate numbers to the study of the relatively small and unsuccessful mammalian order Primates—an order that is, after all, about equal in size and adaptive diversity to the single family of squirrels."

Nuts to Cartmill's view, says Schwartz, and to the conventional wisdom of morphologists and geneticists who see in bone, blood and gene a closer kinship between Man and the African apes than the "man of the forest" (as

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orangutan translates from the Malay language) of Southeast Asia.

Schwartz is not the sort to take no, or yes, for an answer. As he admits here, the "more something has become an evolutionary 'truth' the more inclined I am to try to find out what makes it so."

As a specialist in dental structures of primates and a consultant in forensic anthropology, Schwartz has found in ape-human relatedness just the sort of mystery he can sink his teeth into, and those of other primates as well. In his lighter literary moments he shares his Sherlockian joy at the game of tracing human origins that is afoot. "It's your turn to interrogate the suspects. You start in on *Homo erectus*.

"'Who got you into this in the first place?'" begins his mock-evolutionary grilling of a modern-day human. "'It was *Homo habilis*, wasn't it? And *Homo habilis* got pushed into it by *Australopithecus*. Now you're setting up Neanderthals, aren't you?'"

Asides and analogies—comparing the floor of the nasal cavity to the cutout Halloween jack-o'-lantern nose and noting that changes in gene structure suggest Harpo Marx aping Groucho in *Duck Soup*—animate a very thorough presentation of both the history of anthropological research and Schwartz's own extensive sleuthing.

Schwartz is a cladist, one who classes a species by the features unique to it and its closest relatives. While he acknowledges that the total number of anatomical similarities between the African apes and humans may exceed those we share with the orangutan, he argues persuasively that the significant shared traits are those we and the orange ape possess.

Among those common features are the sort of flat, thickly enameled teeth often seen as a prime humanlike trait, absence of rump calluses, wide separation of nipples, pronounced asymmetry between brain hemispheres, time of gestation and absence of "heat" among adult females—all are characteristics we and orangs share uniquely among hominoids. Add to these a feature, a small opening deep in the skull that Schwartz discovered orangs—alone among the great apes—share with Man.

If in other features, from sinuses to earlobes, we have African apes, not orangs, as partners, Schwartz sees these, and such orang peculiarities as double-jointed hips, cheek pads and throat pouch, as less significant in assigning evolutionary place cards.

He does not gloss lightly over anatomical findings or those from DNA and chromosome analyses that counter his unusual notion of human ancestry. Rather he points out flaws in those studies that, if they do not support him, at least throw into question the prevailing view of the branching of the primate family tree.

Schwartz puts himself well out on a limb, and only in the last paragraph begins a tentative shinny down to safe turf. "Is my theory viable? On many levels, the association of humans closely with orang-utans makes a lot of sense. It brings some order into the otherwise contradictory studies of fossil and living hominoids. In other ways, however, the idea . . . violates some of our most basic concepts of how closeness of relatedness will be revealed in anatomy and especially in molecules," he concludes.

Human evolution may be the truth, but it is a truth not yet fully revealed.

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While reading accounts as earnest and erudite as Schwartz's, or the discrepant views of Donald Johanson or Richard Leakey before him (SMITHSONIAN, June 1980), "you can easily come to the conclusion that only the one you happen to be reading at the time can be believed," as Schwartz himself writes of other scientists and ideas.

If Schwartz is climbing—or just barking—up the wrong human family tree, he has at least filled it with some intriguing arboreal company.

Don Lessem
Massachusetts writer and naturalist

The Mythic West
in Twentieth-Century America
Robert G. Athearn
University Press of Kansas, $25

"Today in the recesses of the Rocky Mountains you come upon steady-eyed, eagle-faced men with tawny mustaches, whose masterful, unswerving will and fierce impatience of restraint remind you of their spiritual kinsmen, the heroes of the Icelandic sagas." The *today* of the quotation is 1912, and the author is Edward Alsworth Ross, a sociologist with an elegant turn of phrase. It is one of the many quotations that fill Robert G. Athearn's *The Mythic West*—often in ideological struggle with one another— and having used Ross, Athearn makes a leap ahead to suggest that he was inadvertently painting "a word portrait of the Marlboro Man." Even without that jump, Ross' remark suggests that the fabled Western hero was always in part cosmetic—look the part and the independence may be taken for granted.

In *The Mythic West*, Athearn sets out to examine the figure of The Westerner, who was invented by nostalgic Easterners and adopted by Westerners whenever the image could be turned to spiritual or actual profit. The book is not a careful analysis of the phenomenon. Each chapter is an essay on some aspect of the author's subject, and the method, as Elliott West, who edited the text after Athearn's death in 1983, says, is "impressionistic." Athearn uses his own experiences and observation (the Prologue is a fascinating double portrait of the small town in which Athearn lived in 1922 and of his grandfather's more primitive ranch where he spent several months that year), magazine articles and published reminiscences, but very little material "from statistical or purely documentary sources." Elliott West wrote one of the chapters—the one on the conservationist and preservationist movements—using Athearn's notes. "Whatever tinkering has been done by others," West says, it "is still Robert Athearn's book alone."

Although Athearn was a distinguished historian of the West with a great many formal works to his credit, *The Mythic West* is apparently just what he wanted—discursive, even chatty; repetitive; elusive and allusive; sometimes even cute ("tin-can tourists . . . whose fat wives, wearing knickers, ravaged wild flowers along mountain streams"). It is characteristic of the book that, having used a kind of amiable invective to dismiss the tourists (were there no thin wives in dresses?), he notes that critics of the changing West complained that "some of the Westerners were beginning to look and to act just like these mindless outlanders."

One of the strengths of the book is that Athearn is as willing to turn a jaundiced eye on his fellow Westerners as he

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Atop Mount Winchell (1888), man of the West, "alone, vigilant, heroic, robust."

is on the outsiders who change the West even as they insist that it must stay fixed in a mythically pure past. "So if you take this to be a history of the twentieth-century West, you'll find it as full of holes as Swiss cheese," he says at the end of the Prologue. "This is the way I intended it."

Athearn's first chapter is called "The Ephemeral West," and in it he suggests that it is as difficult to locate the West in space and time as it is to find the Westerner in his pure state. He quotes George Catlin, who said of the West early in the 19th century, "Phantom-like it flies before us as we travel." For Athearn, the West, which consists of many Wests—plains country, mountains, the desert of the Southwest—is that part of the country beyond the Missouri River reaching to the edge of the pseudo-East that sprang up along the West Coast. The precise boundaries are finally unimportant, for when one speaks of the mythic West one is talking as much about geography of the mind as of real country.

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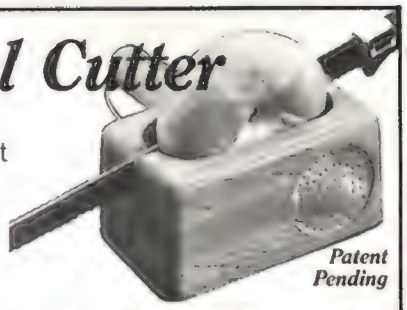

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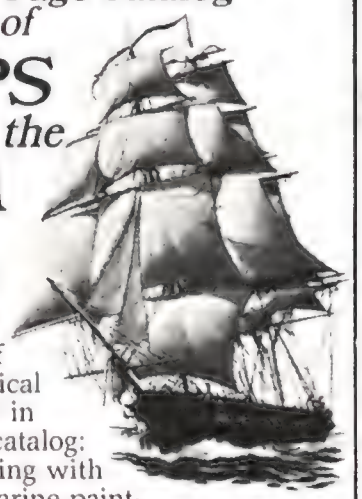

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the Old West to invent an idealized country. That required that a special breed exist to inhabit the rugged land. The Westerner was thought of as a kind of Ur-American, uncorrupted by civilization, a sturdy, independent cuss not about to bow to any man.

As Western towns sprouted drugstores and movie houses like towns elsewhere in the country, Eastern magazines and newspapers lamented the decline of the West. The need for a perennial frontier was so great that the West was newly defined in terms of a fictional Old West, and visitors expected—even demanded—an approximation of the imaginary West.

Oddly, the figure at the center of this West is not the woodsman or the frontiersman, but the cowboy. A largely faceless hired hand, working long hours for small pay, he was turned into a heroic character, as direct and clear as the open sky under which he worked. From Theodore Roosevelt, who Athearn says "was afflicted by a terminal case of cowboyitis," to contemporary small boys savoring staged shootouts in bogus mining towns, the West has been a dream, often a marketable one.

The Western reaction to this Eastern invention of their history has been complicated. At first, it was simply resented as another instance of Eastern colonialism, trying to keep the benighted West buried in the past. In the 1920s, the assumed virtues of the Western hero were taken over by the Western businessman, who saw himself as creator of a new West. It was the merchant versus the farmer (the booster versus the clodhopper), and predictably the East saw the clodhopper as the heir of the Old West. From the Depression on, as Athearn makes clear, Westerners have accepted—even expected—outside support, but have used their celebrated sense of independence to denounce their benefactors, "gnawing at the hand that fed them, while alternating between vituperation and lamentations over the sad role of the enslaved."

The least successful chapter in the book, oddly enough, is the one on Western fiction and films. Since these are the main vehicles for the propagation of the Western myth, they are potentially the richest ground for a study like Athearn's. He never gives any sense that he knows the material firsthand (Gary Cooper did not make it "across an entire movie career with a single word: yup"), and his collection of secondhand quotations, which serves him so well when he is discussing dude ranches or tourist towns or the conservationists, fails him here. What one needs is not reference to a movie specialist, but a close look at, say, Johnny Mack Brown.

Despite this weakness and the occasional sense that one is going—yet again—over familiar ground, the book does a sound job of examining what the mythic West means to Easterners and Westerners alike. There is a lightly mocking tone to Athearn's prose that suggests that he is playing with both sides in the struggle to control both the West and the definition of it. His "Somewhere, deep in those woods, lies the mythic West" sounds a little like Edward Alsworth Ross' "in the recesses of the Rocky Mountains," but Ross wanted confirmation of the myth. Athearn recognizes that the deep woods is the place where lies whatever West we need.

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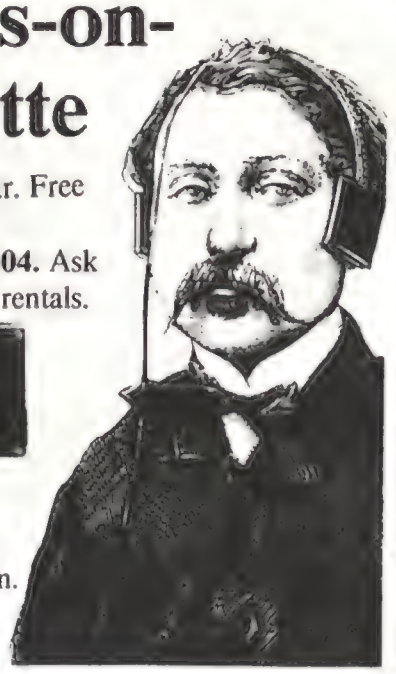

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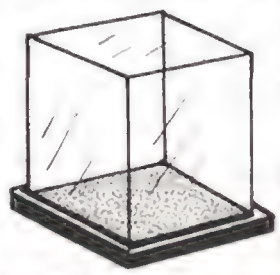

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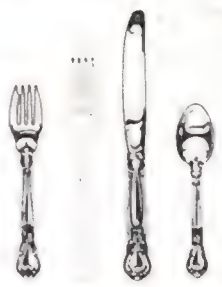

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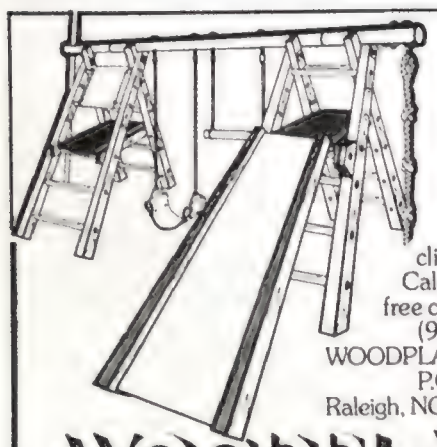

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Special August exhibits and events

Hirshhorn Museum & Sculpture Garden
Roger Brown (August 12-October 18) See *Highlights continued.*

National Portrait Gallery
Recent Acquisitions (August 15-February 14) Paintings, sculptures, prints and photographs.

Portraits from the American Academy and Institute of Arts and Letters (through September 20) Paintings by William Merritt Chase, Augustus Saint-Gaudens, others.

National Museum of American Art
John La Farge (through October 12) Paintings, graphics and stained glass by the versatile 19th-century master.

Cooper-Hewitt Museum (New York)
Art Nouveau Bing: Paris Style 1900 (through October 11) Prints, posters, decorative objects and furniture.
Safe and Secure: Keys and Locks (through October 18) Spans 2,000 years.

National Museum of Natural History
Ebla to Damascus (through January 1988) First major display of archaeological material from Syria in the United States.
Dinosaurs, Mammoths, and Cavemen, The Art of Charles R. Knight (through August 31) Works by the great depicter of dinosaurs and prehistoric environments.
Dinosaurs Past and Present (through August 31) Comprehensive collection of paintings, sculptures and models.
African Harvest Festivals: The Hommowa of the Ga People of Ghana (August 28, noon, Baird Auditorium) Illustrated lecture by Mahama Bawa, president of the Oboade Institute of African Culture, to accompany the Institute's re-creation of a festival at the Sylvan Theater on August 29.
Valley of the Gwangi (August 21, noon, Baird Auditorium) Animated dinosaur science fiction film.
The Secret Leopard (August 7, noon, Baird Auditorium) Filmmaker Richard Matthews' portrait of this rare animal.

National Air and Space Museum
Into the Sunlit Splendor (through December 31) Forty paintings by aviation artist William S. Phillips.
Fly-by-Night Family Night (Friday evenings through September 4, 6-9 P.M.) Games, contests, demonstrations, more.

Renwick Gallery
Dan Dailey: Glass, 1972-1987 (through October 25) Vases, sculptures, drawings.

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Into the Sunlit Splendor: The Aviation Art of William S. Phillips (paper, $5)
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Alvar Aalto: An Architectural Legacy (August 13; 8 P.M.) Aalto's widow describes career of the Finnish master.

Japan at War: Rare Films from World War II (August 4, 11, 18; 7 P.M.) Series from Kawakita Memorial Film Institute.

Irving Berlin at 99 (August 19; 7 P.M.) An outdoor concert at the National Portrait Gallery by the Hot Mustard Jazz Band.

Mad Romance and Ice Cream! (August 20; 7:30 P.M.) The vocal quartet performs jazz and pop followed by ice cream social.

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Here are some August exhibits:

Chicago (August 15-November 29) *Hooray for Yiddish Theater in America!*, Spertus Museum.

Las Cruces, New Mexico (August 20-September 27) *Daughters of the Desert: Women Anthropologists and the Native American Southwest, 1880-1980*, New Mexico State University Museum.

Oklahoma City (August 5-September 10) *Lights, Camera, Action! Lithographs for the Cinema by Jean A. Mercier, 1920-1940*, Kirkpatrick Center.

Orono, Maine (August 6-September 18) *Treasures of the Land: New Zealand Craftsmen and Their Native Materials*, Hudson Museum.

Richmond, Kentucky (August 16-September 14) *South of Winter: Scenes from the Aransas Wildlife Refuge*, Giles Gallery, Eastern Kentucky University.

San Diego (August 1-September 13) *New Vistas: American Art Pottery 1880-1930 from the Cooper-Hewitt Museum*, Museum of San Diego History.

Tupelo, Mississippi (August 15-September 13) *Drawn from the Sea: Art in the Service of Ichthyology*, Tupelo Art Gallery.

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Roger Brown at the Hirshhorn

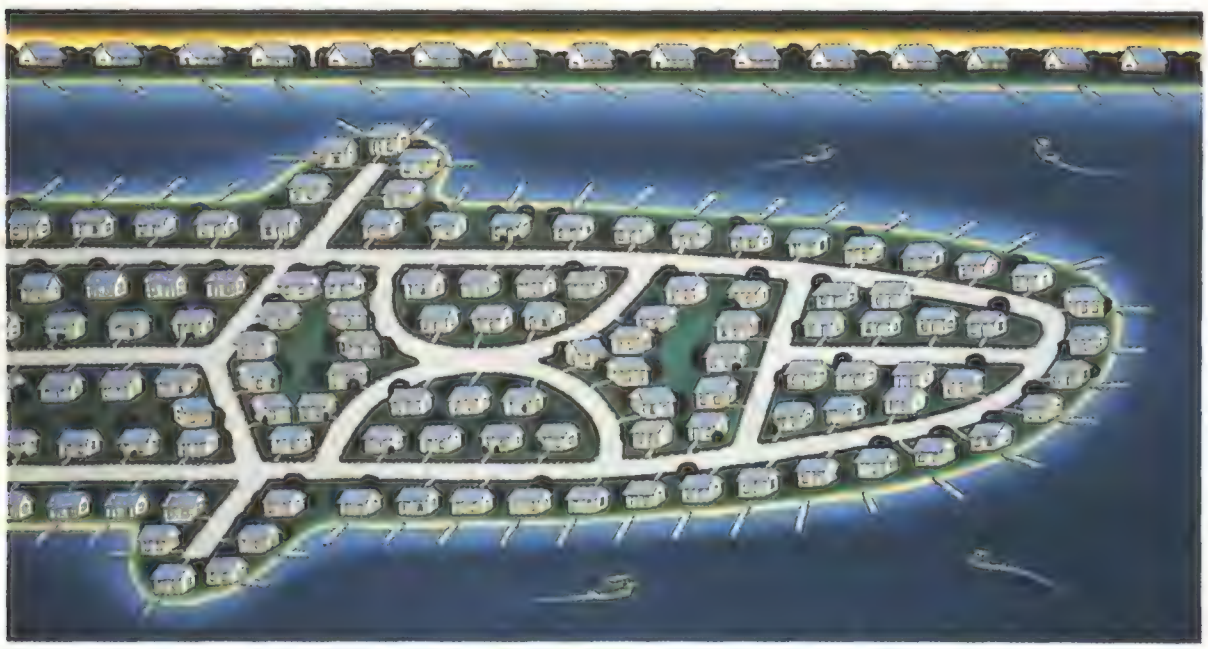
Although he settled in Chicago as a student in the 1960s and has painted there ever since, Roger Brown doesn't consider himself an artist identified with a particular region. "I could work anywhere," he says in his studio on Halsted Street. Drawing on the wide reaches of his own imagination, Brown has created evocative, powerful canvases that reveal his expansive vision of America.

His landscapes, rooted in memories of travels that have taken him the length and breadth of this country, at once celebrate the beauties of the land and mourn the ravages visited upon it. A Long Island subdivision or a Midwestern field, rendered in his patterning, summon up every suburb, every rolling pasture we have known—or dreamed of.

The landscapes, though, represent only a fraction of Brown's work. Whether he is documenting contemporary events (such as the Attica prison uprising or Kennedy assassination), re-creating the mystery of a movie theater interior or paying homage to Chicago's architecture, his brooding, bold imagery signifies an American master.

The show, which runs from August 12 to October 18 at the Hirshhorn Museum, also travels to La Jolla, Coral Gables and Des Moines.

Kathleen M. Burke



Nassau County: A Time-Photo Alteration evokes suburbia's mesmerizing monotony.

Grounded in incongruity, *Sequoia* depicts the venerable trees as sightseers' icons.

Quilted Landscape draws on folk tradition's eye for engaging pattern.

Artist found barren hills of *Lewis and Clark Trail* "disgusting to drive through."

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Domestic Study Tours

Alaska's Inside Passage August 18-25: This exclusive cruise for only 78 Associates visits remote and scenic places inaccessible to larger ships.

Colorado Mining and Railroad History August 20-29: Relive the golden age of trains in your own elegantly restored private car; discover the romance of the Old West in Ouray, Durango and Cripple Creek.

Maine September 19-28: Rocky coasts, pine forests, mountain vistas await you on this invigorating hiking tour for all ages.

Philadelphia October 1-4: Lectures and tours focus on 18th-century Philadelphia and the making of the U.S. Constitution.

California Wine October 3-9: Learn about wines for all occasions. Visit wineries in Napa, Sonoma and Mendocino with experts.

California Delta Cruise October 9-12: Cruise in the wake of the Gold Rush sternwheelers. Start from San Francisco to discover the Sacramento and San Joaquin rivers, rich in history and legend.

New York Architecture—From Cast-Iron to Post-Modern October 22-25: Enjoy a weekend of walking tours, a private cruise around Manhattan and Broadway's *Les Misérables*.

Florida Keys October 24-30: Return to camp as an adult at Seacamp on Big Pine Key; explore mangroves, tidepools and colorful coral reefs with marine experts.

National Air and Space Weekend November 6-8: Explore air and space travel with curators and special guest astronaut. Program features private tours of the museum and its restoration-and-storage facility.

Christmas at the Smithsonian December 4-6: Welcome the holidays with tours, music and festive dining. Visit the new Museum of African Art, Haupt Garden and Sackler Gallery.

Everglades December 5-12: For the novice or expert, canoe and camp among Florida's Ten Thousand Islands.

Christmas in Santa Fe December 20-27: Experience the festive traditions of the Spanish and Indian cultures of the Southwest.

Florida Springs February 6-10: Canoe the freshwater springs of central Florida and see the endangered West Indian manatee.

Hawaii February 20-March 3: Experience undersea wonders, great volcanoes, lush forests and whale watching.

Baja Whale Watch February 22-March 1 or March 1-9: Explore beauty of Baja California in company of gentle gray whales.

Foreign Study Tours

People's Republic of China Follow the Silk Road, climb sacred peaks, cruise the Yangtze, travel by train, study decoration and antiques or visit Tibet. Tours for new and repeat China travelers.

Alpine Hike August 16-30: A challenge for adventurous hikers through the majestic mountains and valleys of Switzerland.

London and the English Countryside August 30-September 13: Design your own nine-day London program, then enjoy five extra days on a countryside excursion.

Oxford Smithsonian Seminar September 11-26: Be an Oxford scholar. Attend classes and field trips.

Canadian Rockies September 14-23: Mountains, hot springs and resorts beckon hikers to Banff, Jasper and Lake Louise.

Scandinavian Design: Past and Present September 20-October 4: Enjoy a wealth of artistic expression. See museums, galleries, design ateliers, artists' studios.

Irish Walk September 24-October 6: Stay in castles and take day hikes through the Ring of Kerry and Connemara.

In Pursuit of Brazil October 6-23: An enormous land of contrasts and exuberance to fascinate you. Includes Rio de Janeiro, Brasilia and Iguaçu Falls.

Highlights of Austrian Civilization October 10-25: Live in a baroque palace in Salzburg and a charming hotel in Vienna while studying music, art and history.

Japan Journey October 11-24: An excellent introduction to Japanese culture in Kyoto, Tokyo and the countryside.

Australia-New Zealand October 11-November 3: An intriguing introduction to natural history and culture down under.

Christmas in Europe Celebrate with fellow Associates in one of four idyllic settings: Munich and Rothenburg; Salzburg and Vienna; Canterbury; or Winchester.

Christmas in Fiji December 17-29: Enjoy the holidays in a South Sea island setting. Reside at the intimate Namale Plantation overlooking the Pacific.

Backstage London January 1-10: In Europe's theater capital, attend traditional and avant-garde productions, meet performers backstage.

Thailand and Burma January 9-29: In Asia's most exotic countries, explore colorful cities, remote villages and archaeological sites.

South America Voyage January 9-February 2: Cruise from Brazil through the Strait of Magellan and Beagle Channel to Santiago, Chile.

Performing Arts of Russia January 10-24: Enjoy the best of Russian ballet, opera, symphony, folk dance and theater.

Siberian Winter Odyssey January 24-February 6: A thrilling winter exploration awaits you—dash through majestic countryside in a troika, ride the Trans-Siberian Express.

Coming in February: Mesoamerica study programs. Three tours in Mexico and Guatemala—Yucatán Adventure, Zapotec and Maya Mexico, Guatemala Adventure. Explore archaeological treasures, natural beauty.

Write Smithsonian National Associates, 1100 Jefferson Drive, SW, Washington, DC 20560 or call (202) 357-4700 for tour brochures

Washington

Smithsonian Seminars

Join your fellow Associates for a week of discovery and adventure at Smithsonian Seminars in Washington, D.C. and at other locations around the country. These specially arranged courses offer you the chance of a lifetime to take an active part in the Smithsonian's varied research activities.

Aircraft Restoration: A Closer Look
November 8-14

For aviation enthusiasts, there is nothing quite like it. In a score of buildings sprawled across 21 acres in Silver Hill, Maryland, the National Air and Space Museum's Paul E. Garber Facility contains more than 40,000 aviation artifacts, highlighted by a unique collection of aircraft that have been painstakingly restored by master craftsmen. Discover this remarkable facility during in-depth tours and workshops by skilled artisans who will acquaint you with the challenges of restoring vintage aircraft as diverse as the Vought OS2U-3 Kingfisher, the Spad XIII and the B-29 *Enola Gay.*

Intensive workshops and demonstrations will begin with the analysis of aircraft "remains." You will then learn the fine techniques of woodworking, fabric covering, doping, painting, corrosion control, metalwork and assembly. During private tours, you will see almost 200 finished aircraft as well as a superb collection of engines, armament and flight-related memorabilia. Complementing your sessions at the Garber Facility are tours of the aviation galleries to see the historic aircraft at the Air and Space Museum. Celebrate the conclusion of this exhilarating week with a screening of the museum's IMAX film *On the Wing*. Hotel accommodations at the Capitol Holiday Inn are optional.

Coming Up: From January 10-16, 1988, enjoy a first-time opportunity to go behind the scenes, view world-famous collections and meet the curators at the Smithsonian's new Arthur M. Sackler Gallery and National Museum of African Art. Watch this column in September for further details.

For Associates who wish to study with Smithsonian scholars outside of Washington, seminars will be held in 1988 at the University of Southern Mississippi in Hattiesburg; Mohonk Mountain House at New Paltz, New York; in Phoenix, Arizona; and in Vail, Colorado.

or (202) 357-1350 for seminar brochures.

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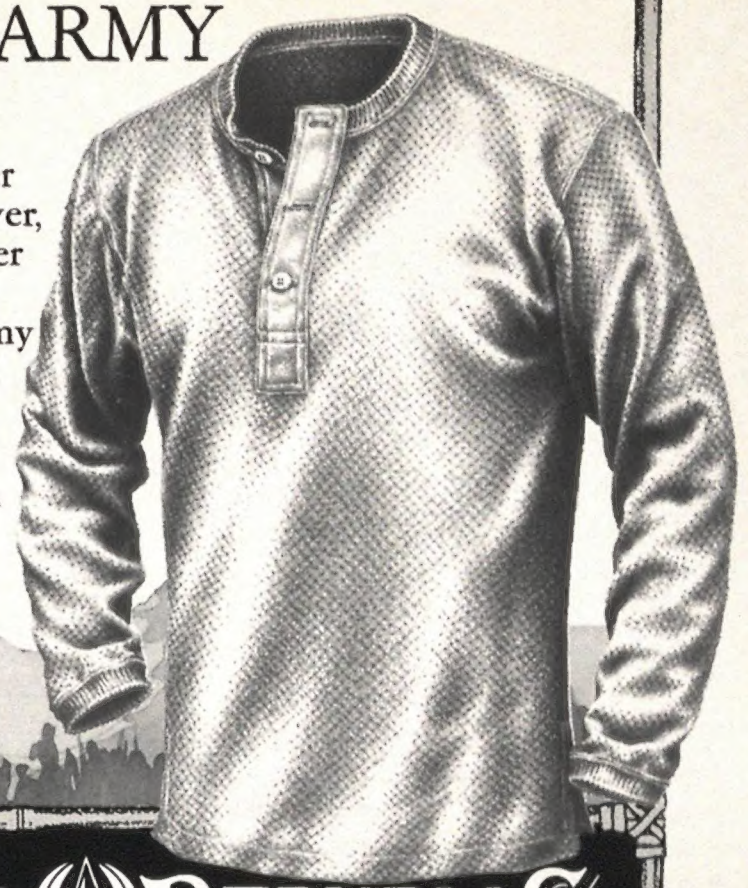

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By Raymond Lovett

'Therapist Dyed, Sessions Canceled'

The best sign my troubled mind could conjure up was THERAPIST DYED, SESSIONS CANCELED. I sat behind the thick soundproof door to the waiting room, terrified about greeting the first patient of the day. Why was I afraid?

I have changed, that's why! I look different. Over the weekend I dyed my hair. Oh, not to deceive clients about my age or anything like that. It was sort of an accident.

You have to realize that I am one who has long seen T. S. Eliot's J. Alfred Prufrock as a kindred soul. Prufrock I recognized as full of promise, ambition, guts—all secret, of course—but fuller still of paralyzing fear. Some of his remarks, as he measured out his life with "coffee spoons," were recorded on an inner tape that kept on playing as life came at me: "And indeed there will be time/ To wonder, 'Do I dare?' and 'Do I dare?'/... Shall I part my hair behind? Do I dare to eat a peach?"

If anyone loves a shy man, it is another shy man. I once considered a J. Alfred Society, but was too undaring to get it started. And in a way J. Alfred was what caused me to dye.

For her 40th birthday a friend threw a big party inviting all the guests to return to the 1950s. My wife donned saddle shoes with bobby socks, a poodle skirt, curled her hair in bouffant style and slashed on bright red lipstick. I borrowed a letter sweater, hauled out my old Converse sneaks and undesigned Levis, laid in a supply of Wildroot Cream Oil, and acquired a wide, ugly tie with clashing shirt to match.

But I felt the need for something more, some daring outrageous gesture that would cure my midlife blues, maybe ease my attachment to Prufrock. It came in a flash: I would dye my graying hair. Until that very moment, needless to say, I had figured dyeing your hair was tantamount to wearing a skirt or earrings, or carrying a delicate bag. So this would be a freeing deed.

Dyeing was quick and easy. In 45 minutes, with my 12-year-old son reading the directions, I applied a pungent, ammonia-based solution, braving threats of explosion if the stuff was mishandled. What *is* this glop women use?

Judging by the response from the people at the party, the new hair hue, Navy-shoe black, was as noticeable as nakedness. I felt energized, playful, danced better than I had ever danced before. I nearly forgot to cringe when my wife and I were voted best-dressed. But then came the morning after.

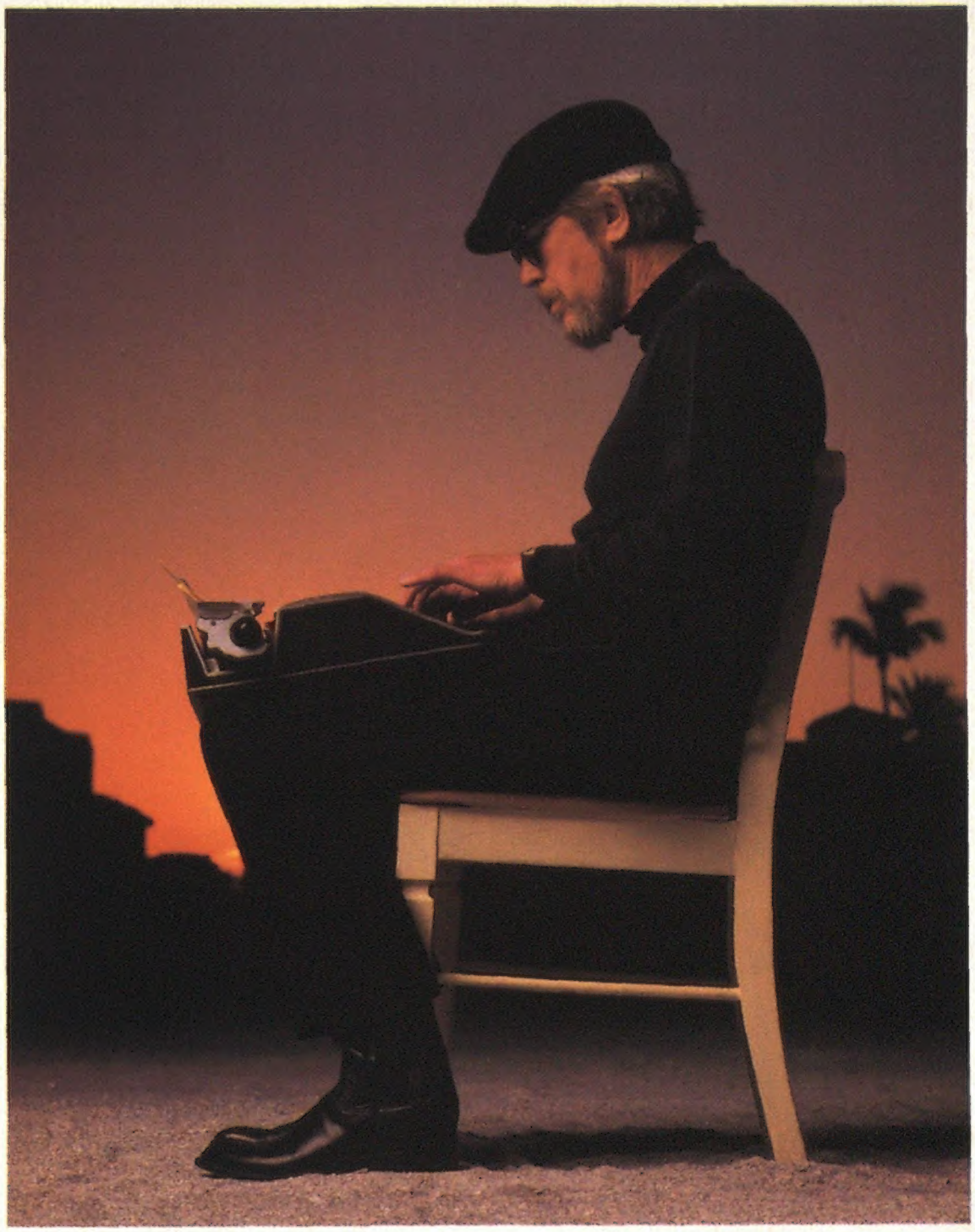
Somehow I had the idea that the stuff I put on would shampoo off easily. Cheerfully I shampooed once. Then twice. No result. Shampoos three and four followed. Several more were administered with increasing desperation, but not a shade of blackness left my head. A beautician studied my empty bottle, examined my hair, then applied strong-smelling fluid. Nothing doing. I tried eggs, eggs and peanut oil, liquid detergent both with and without peanut oil, the world's strongest shampoos. Still no dice. Desperation escalated to panic. As a psychotherapist I listen to people tell me about their feelings and pain. A theme that continually surfaces is authenticity. In the morning I would have to face these troubled folks with a head of clearly inauthentic hair!

As I rushed to the office early Monday, blackness reigned in head and soul. So, yes, indeed, the words "Therapist Dyed, Sessions Canceled" danced in my head as I forced myself to open the door to the first patient, hoping she wouldn't notice. But at first glance she shouted, "My God, what have you done to your hair?" Prufrock seized my soul: "I should have been a pair of ragged claws/ Scuttling across the floors of silent seas." As she explored her fantasies about my change of color, my inner self rapidly ran through another appropriate sign for the door: REGRESSED TO THE FIFTIES, WILL CALL ON RETURN.

I sat through 25 reactions, ranging from silence and whispered gasps to changing-gender fears and loss of hold on reality. When the final patient had reacted, I considered writing an article about all the material stirred up in the unconscious by dyeing. Maybe dyed hair could replace the Rorschach test.

As any therapist will tell you, some mistakes are corrected solely by growth. Getting that black out of my hair proved to be one of them. Perhaps a Prufrock-free man would have embraced the new color for good. Not me. In 12 weeks I had returned to my gray life, enriched now with a new respect for the word "temporary," plus a visceral reaction to the smell of ammonia. I hoped, too, that maybe I had taken a bite out of the rigid knot of shyness that has so long sabotaged my social courage. After all, wasn't it better to have dyed and been discovered than never to have dyed at all? No more coffee spoons for me!

Such bold feelings beckoned me to the racetrack (first time ever), encouraged me, upon arrival, to smile shyly as I courageously clung to a raincoat-camouflaged wicker basket full of fruit and illegal beer. Once seated, I raised the basket by one handle, releasing the cover. Three cans clanked down a long flight. When the drumroll stopped, a security guard joined a rubbernecking crowd to stare at the exposed beer smuggler. Remnants of Prufrock surfaced instantly. I felt my face grow red. I ran a nervous hand through my hair. Then, utterly calm, I reached for a peach and bit into it. As the sweet nectar trickled down my chin, I smiled triumphantly. I had not dyed in vain.



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